Chemical Engineering

A McGRAW-HILL PUBLICATION

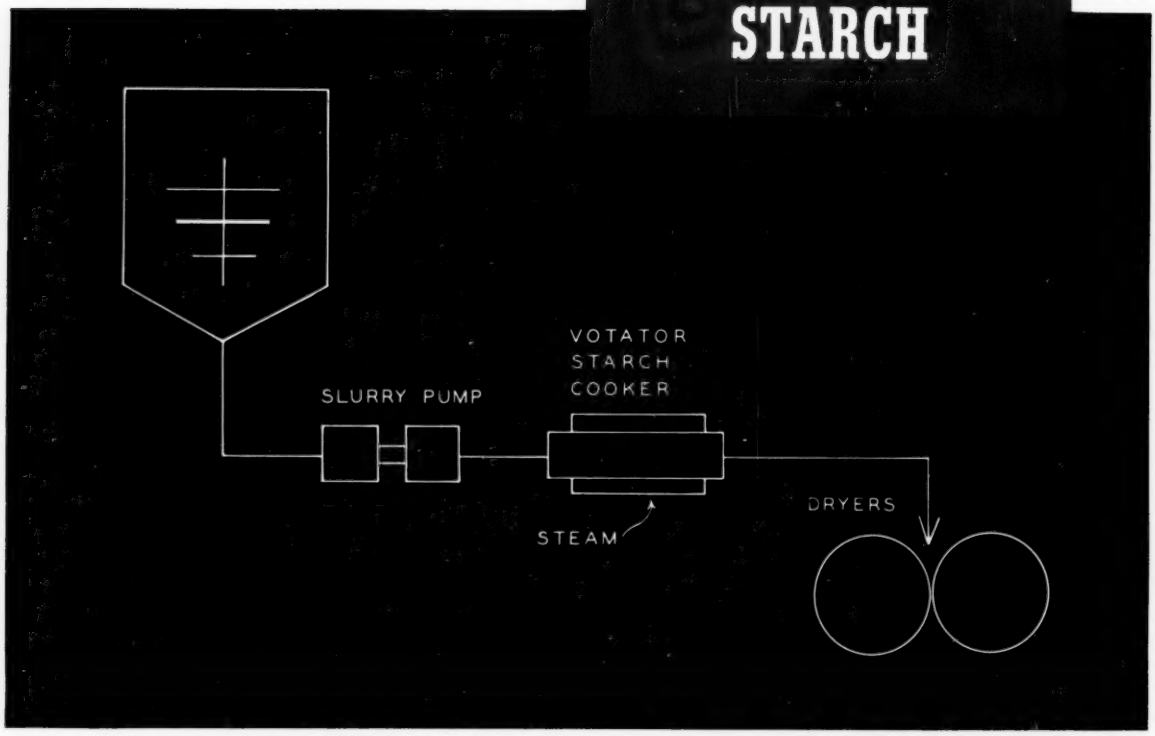
MAY 5, 1958

Published every-other-Monday

Seventy-five cents

PROOF THAT CHEMICAL ENGINEERS CAN FIND SATISFACTION AND REWARD IN GOVERNMENT SERVICE

PREGELATINIZED STARCH



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LEADING manufacturers of pregelatinized starch report these important benefits with VOTATOR* Starch Cookers, compared to conventional methods:

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MAY 5, 1958

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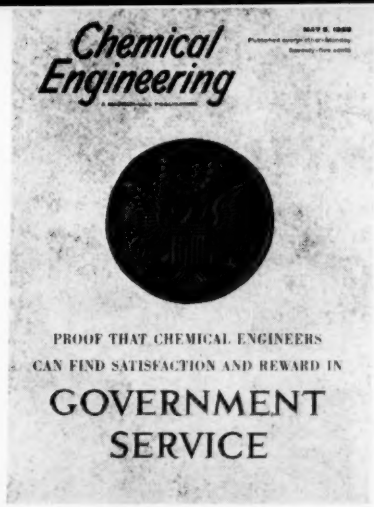

NINTH OF TWENTY-SIX ISSUES

9/26

GUIDED TOUR

Who's Pioneering What

New processes have always been the life-blood of the chemical process industries.

Yet until 1951 there was no one place where you could find a convenient checklist of recent advances in chemical technology.

In that year CE's editors, refusing to tolerate this big gap, compiled their first inventory of new processes and technology. It was a modest, 2-page listing of 62 projects.

In this issue we're publishing our eighth inventory—a 14-page boildown of 291 key advances on the frontiers of chemical technology.

These eight inventories have listed close to 2,000 of the most significant developments taking place in the chemical process industries since 1951 . . . statistical proof of the growth and vitality of the CPI.

This year's tally falls into 11 categories. A brand new section on nuclear technology chalks up 32 new projects; petroleum and natural gas lists 33; metals—reflecting the rapid shift toward chemical methods—boasts 39 listings for 1958, three times the tally for 1952!

I'd like to stress that we've tried to be selective in screening all items so that only the most significant make the grade.

Also, since these are new processes—often still under development—details aren't always available. But we've included key facts (and only these) wherever possible.

CE's exclusive 1958 inventory of new processes and technology . . . a bird's-eye sweep of which way CPI technology is headed . . . is your guide to who's pioneering what on our process frontiers.

You'll find it on p. 125.

Uncle Sam—employer of engineers—offers more satisfaction than you think

More than a thousand chemical engineers now work for federal agencies throughout the country. Contrary to what some people think, they're hard-working and capable men. And young engineers would be wise to take a hard look at the challenges and rewards that can come with a career in government service. (p. 161)

Rationed air: key to kiln success

Old-fashioned rotary kiln has stolen a march in the field of solids-gas contacting. New kind of control holds gases at uniform heat. Now being used for reduction of iron ore without melting. (p. 52)

Petrochemicals' 1958 opportunity

When steel output sags—as it has—there's less coke and coal chemicals. That's

Chemical

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GUIDED TOUR

why refineries now have a first-class opportunity to swell oil's share of the benzene-toluene-xylene market. (p. 78)

Quick quench leads to profits

Highlight of new perchloroethylene process is a quick quench in HCl. Bypassing old multi-step route saves on raw materials; cuts side reactions that shrink efficiency and profits. (p. 116)

Who's pioneering what and how

Our exclusive and continuing inventory of advances in processes and technology takes you again to the frontiers of the chemical process industries. It's a fact-packed convenient guide. (p. 125)

Guide to best air pollution control

If you'll keep these new guides and examples handy when you design air pollution control systems, you'll never overlook any key factors. Practical help for a ubiquitous problem. (p. 139)

CE is edited for the engineer concerned with chemical operations, whatever his function . . . administration, production and plant operations, design and construction, research and development, sales and purchasing. More engineers subscribe to CE than to any other magazine in the field. Print order this issue:

47,662

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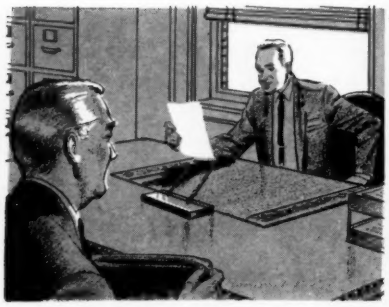
HOW YOU CAN BE SURE YOUR **SOLID-LIQUID SEPARATIONS** AREN'T COSTING YOU TOO MUCH

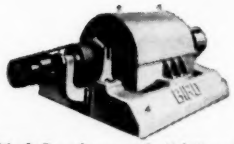
Don't let existing methods and equipment go at that.

Making certain that this vital part of the process is being done in the most effective, most economical way involves just two simple steps:



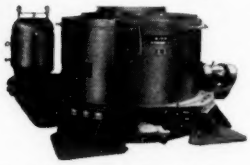
1 Talk it over with technical experts on solid-liquid separations with twenty-eight years of experience to draw on and with the company that engineers and builds the most complete range of equipment for this purpose.

2 Make use of the finest facilities available for solid-liquid separating tests, staffed by engineers who specialize on this single, important phase of chemical processing — at the Bird Research and Development Center.



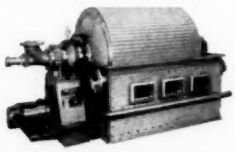
Bird Continuous Solid Bowl Centrifugal Filters

Bird Continuous Screen Type Centrifugal Filters



Bird-Humboldt Oscillating Screen-Centrifugals

Bird-Prayon Horizontal Tilting Pan Vacuum Filters



Bird-Young Continuous Rotary Single Cell Vacuum Filters

Bird Suspended Batch Centrifugals

Bird Horizontal Tank Vertical Leaf Pressure Filters

LEADING AUTHORITY ON SOLID-LIQUID SEPARATIONS

BIRD
MACHINE COMPANY

SOUTH WALPOLE, MASSACHUSETTS
Regional Offices:
ATLANTA 9, GEORGIA **EVANSTON, ILLINOIS**
WALNUT CREEK, CALIFORNIA

Chemical Engineering

This issue's top features of significance in

Petrochemicals & Petroleum Refining

Petroleum aromatics headed for hearty times 78

This year, petroleum sources of aromatic chemicals have a juicy chance to influence friends and win new markets —as steel's slump thins yields of coke-oven chemicals by 40%.

Perchloroethylene process features fast HCl chill 116

Besides raw material economies, this process features an HCl quench system that quickly chills reactants from chlorination furnace to freeze conversions at high value.

CE's roundup on processes and technology 125

Here are the top technological developments—in the opinion of our editors—which have turned up in the hard-pacing chemical process industries since mid-56.

For better air in and around your plant 139

The fumes which puff out of most petrochemical plants can lead to yield losses and bad community relations. Here's what to keep in mind for effective pollution control.

Estimate surface and interfacial tensions 143

Here are methods that will help you approximate the temperature dependence of surface tension and the variation caused by composition changes in mixtures.

CIP builders give approving nod to plastic paneling . . . 152

Petrochemical plant builders are looking to translucent reinforced plastic panels which snub chemical attack and corrosion; offer high strength and low cost, too.

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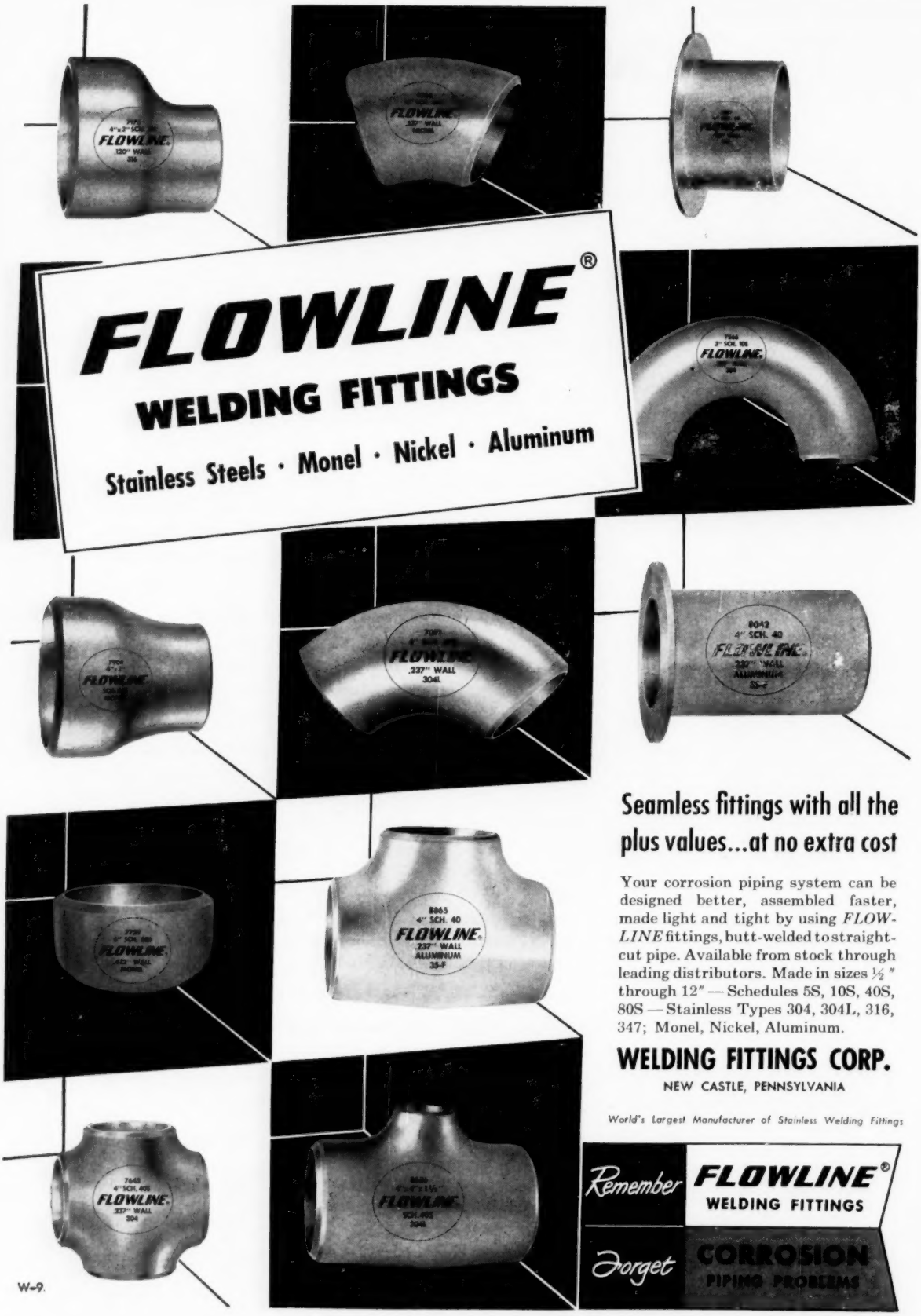

Seamless fittings with all the plus values...at no extra cost

Your corrosion piping system can be designed better, assembled faster, made light and tight by using *FLOWLINE* fittings, butt-welded to straight-cut pipe. Available from stock through leading distributors. Made in sizes ½" through 12" — Schedules 5S, 10S, 40S, 80S — Stainless Types 304, 304L, 316, 347; Monel, Nickel, Aluminum.

WELDING FITTINGS CORP.

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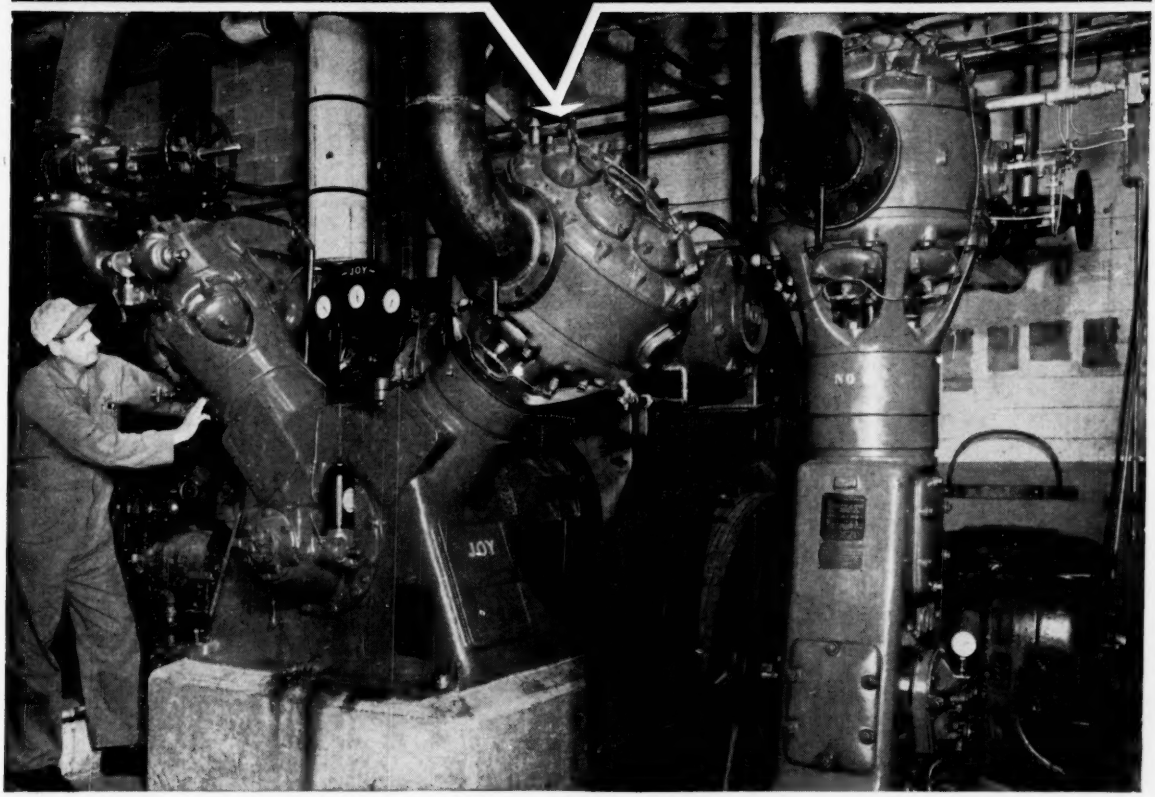

A West Coast Company needed more oil-free compressed air . . . in a hurry! However, there just wasn't any space in the boiler room for additional machines. They had been operating two Joy WG-9 OL vertical compressors (the machine at right in the photo). These non-lubricated compressors had run continously . . . 24 hours a day . . . for *17,000 hours with no down time.*

So they again called Joy in on the problem. The solution: One WG-9 OL with 75 hp was taken out and replaced with a Joy WN-112 E-OL rated at 150 hp. This 974 cfm machine supplies plenty of air for the new equipment, yet is compact enough to fit into the small space available.

If you need oil-free air take advantage of Joy's more than 25 years of experience with non-lubricated compressors. Write ***Joy Manufacturing Company, Oliver Building, Pittsburgh 22, Pa.*** In Canada: *Joy Manufacturing Co. (Canada) Limited, Galt, Ont.*

Write for FREE Bulletin 130-11

Consult a Joy Engineer

For Air and Gas Compressors, Vacuum Pumps and Boosters, Conveyors, Fans, Electrical Connectors.

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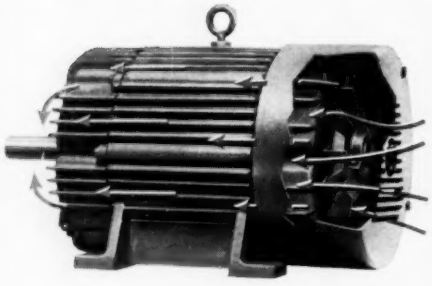
SPECIALISTS IN THE COMPRESSION AND MOVEMENT OF AIR AND GASES SINCE 1885



The original C-W fin-cooled, self-cleaning design which provides more cooling area—no internal passages to clog.

ELLIOTT C-W EXPLOSION-PROOF MOTORS

self-cleaning . . . self-cooling

Designed especially for hazardous locations

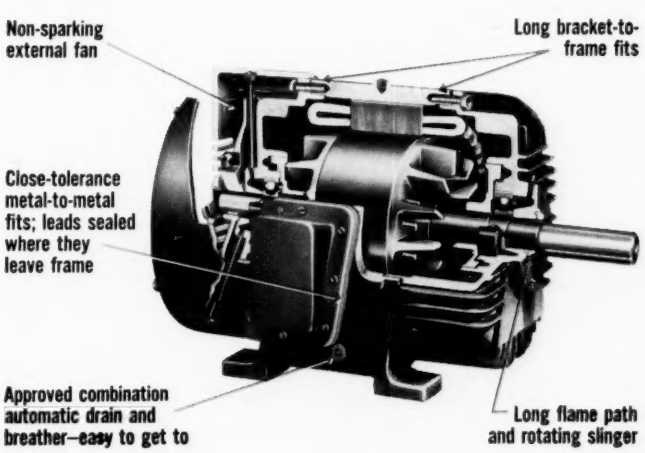
Elliott explosion-proof sealedpower motors are approved by Underwriters' Laboratories for applications in hazardous locations, indoors or outdoors. They have an excellent service record in refineries, natural gasoline plants, pipe lines, chemical plants, etc. . . . wherever explosive atmospheres may exist. NEMA frames through 505, ratings to 100 hp. Ask your Elliott representative for detailed literature *today*.

ELLIOTT Company

CROCKER-WHEELER PLANT, Jeannette, Pennsylvania

W 8-3

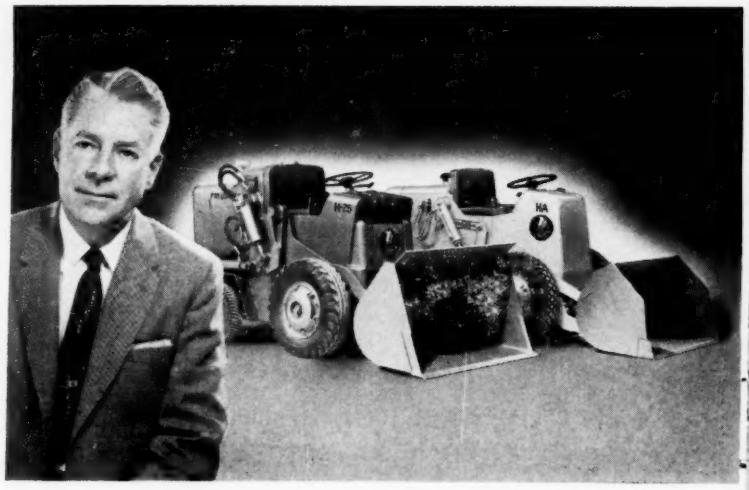
5 important construction features provide safety and reliability


Non-sparking external fan
Long bracket-to-frame fits
Close-tolerance metal-to-metal fits; leads sealed where they leave frame
Approved combination automatic drain and breather—easy to get to
Long flame path and rotating slinger

Underwriters Approved—for Class I, Group D, frames 182 through 256U . . . for Class I, Group D, frames 284U through 326U . . . for Class I, Group D and Class II, Groups F and G, frames 364 through 505

Report on the All-New Model H-25 **PAYLOADER**®

by G. A. Gilbertson,
President of The Frank G. Hough Co.



Recently I had the pleasure of personally delivering the 10,000th production model HA "PAYLOADER" to our distributor in the metropolitan Chicago area.

Because our company pioneered the first unit-designed, rubber-tired front-end loader and because this quantity of 10,000 of a single model is more than all other manufacturers combined have produced, we were justifiably proud of our accomplishment and the acceptance of our product by industry.

Inasmuch as we anticipate a continued demand for this model HA, we plan to continue its production, even though we are now introducing a completely new machine, the model H-25.

More "Payloader" Pioneering

This new H-25 "PAYLOADER" is in a class by itself as far as capacity, productive ability and features are concerned. It is a quality machine in ***every*** sense of the word.

While it will be priced higher than the model HA, and units competitive to that model, it will be a profitable investment, since it can handle materials at a ***lower cost per yard*** and that, in the final analysis, is ***most important*** to the user.

In this connection, your Hough Distributor has available the broadest and most complete set of financing plans offered: time payment and leasing plans, with or without option to purchase . . . any and all kinds of financing to best fit your needs.

What is so different about the new H-25?

More Capacity and Maneuverability

In terms of capacity alone, it is in a class by itself . . . the only machine with a ***carry capacity*** of 2,500 lbs., at average operating speeds of 4 m.p.h.

With a bigger and heavier unit having more capacity, it would be logical to expect you would need more room to operate. On the contrary, not only can this new H-25 negotiate 6-foot box car doors with ease . . . it actually has a turning radius (measured to the outside rear hub) which is LESS than ANY other rubber-tired tractor-shovel.

How Important is Carry Capacity?

How much a loader can handle and move depends on the ***carry capacity*** . . . not on the static lifting capacity. The proper size of the bucket for any loader depends on the ***average weight*** of the material to be handled ***in relation*** to the machine's ***carry capacity.***

Thus, with the H-25 "PAYLOADER" if you want to handle the maximum load of material weighing 125 lbs. per cubic foot, you can use a bucket with an S.A.E. rated capacity of 20 cu. ft. and move loads of 2,500 lbs., which is the carry capacity of the unit.

If you consistently handle heavier materials, you should use a smaller bucket or if you handle nothing but lighter loads, you can use a bigger bucket. The ***important*** thing is to stay within the recommended carry capacity.

The H-25 Has Extra "built-in" Strength

Regardless of its size and recommended capacity, some operators will always push equipment to extremes. This abuse will inevitably result in extra maintenance and even failure. That is why we have engineered extra strength and stamina throughout the H-25 . . . for your protection.

What About Individual Features?

There are dozens of them! The new power-shift transmission and a new torque-converter are matched

to give the ultimate in speed and ease of operation. The H-25 has a two-speed, full-reversing transmission. Power-steering adds to handling ease.

This new "PAYLOADER" is equipped with sealed, self-adjusting brakes and is the only unit of this class offering this important feature.

The H-25 has a maximum dumping height that is 6½ inches higher than the average of other loaders now being offered in this general capacity range.

This new unit is powered by a 44 HP gasoline engine with overhead valves for better performance and wet sleeves for easier maintenance. LPG (liquified petroleum gas) and diesel power are available.

Dig-ability?

When it comes to digging power, the H-25 gives you 4,500 lbs. of breakout force and, like other "PAYLOADER" front-end loaders, provides a bucket tip-back of 40 degrees, ***at ground level!*** As the bucket raises, a further tip-back to 65 degrees helps retain maximum loads.

Protective Features

If you are concerned with dust and dirt like most chemical, fertilizer and foundry operators are, you will appreciate the extra protective features engineered into the H-25. For example, the engine is afforded maximum protection with triple air cleaners — a precleaner and dual oil-bath air cleaners.

This "PAYLOADER" has a filtered hydraulic system. The oil reservoir is a closed, pressure-control type, electrically welded.

The sealing of the majority of all pivot points reduces maintenance. Transmission and torque-converter oil is cooled by the engine radiator cooling system.

Other Features

This new H-25 is equipped with high-traction differential which automatically transfers more torque to the drive wheel with the best footing when slippage is encountered.

The fuel tank has sufficient capacity for eight full hours of operation, thereby eliminating the need for refueling during any shift.

The H-25 is equipped with a 12-volt electrical system. In addition to the usual standard equipment that includes fuel gage, oil-pressure gage and engine temperature gage, there is also a torque-converter temperature gage and an Hourmeter.

There are many, many more features which we think you will be interested in. The many interchangeable attachments now available for the model HA "PAYLOADER" can also be used on the new H-25. Contact your "PAYLOADER" distributor or write us direct for literature and specifications. The Frank G. Hough Co., 754 Sunnyside Ave., Libertyville, Ill.

5-A-1

Modern Materials Handling Equipment
THE FRANK G. HOUGH CO.
LIBERTYVILLE, ILLINOIS
SUBSIDIARY—INTERNATIONAL HARVESTER COMPANY

The H-25 "PAYLOADER" will be shown at both the FOUNDRY SHOW in Cleveland, May 19-23 and the NATIONAL MATERIALS HANDLING SHOW also in Cleveland, June 9-12, 1958.

Looking for cost leaks? Look at your steam traps

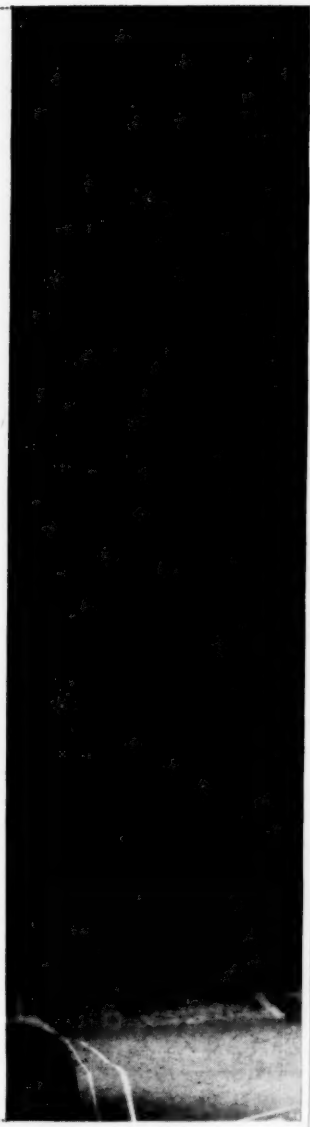
Engineering approach to steam trapping can save thousands a year on costs of fuel, trap maintenance, process cycle time, and uniformity of product quality

Plant and process engineers all across industry have found that Sarco *Production-Planned* steam trapping can pare operating costs by thousands of dollars a year.

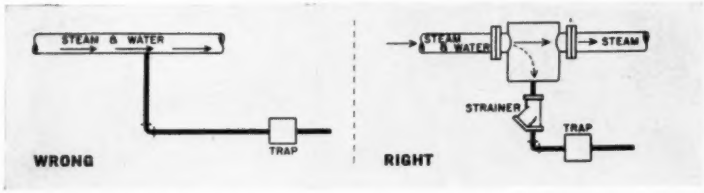
Production-Planned steam trapping is an engineering approach to the problem of getting full design values of heat transfer from steam using equipment. Scores of case histories show that it can make substantial savings and improve processing efficiency. At the same time, costly trap maintenance can be greatly reduced.

In Sarco *Production-Planned* steam trapping, traps are matched to the job by *type* as well as size. They are properly placed, correctly installed. And, to keep down maintenance and replacement costs, every trap is top-quality.

It may pay you well to take this engineer's-eye view of *your* steam trapping. And why not have a Sarco representative look over your system with you? His suggestions will be completely objective because Sarco—and only Sarco—makes a steam trap for every basic requirement. Quality? Recognized everywhere for half a century.



Production-planned systems make best use of traps



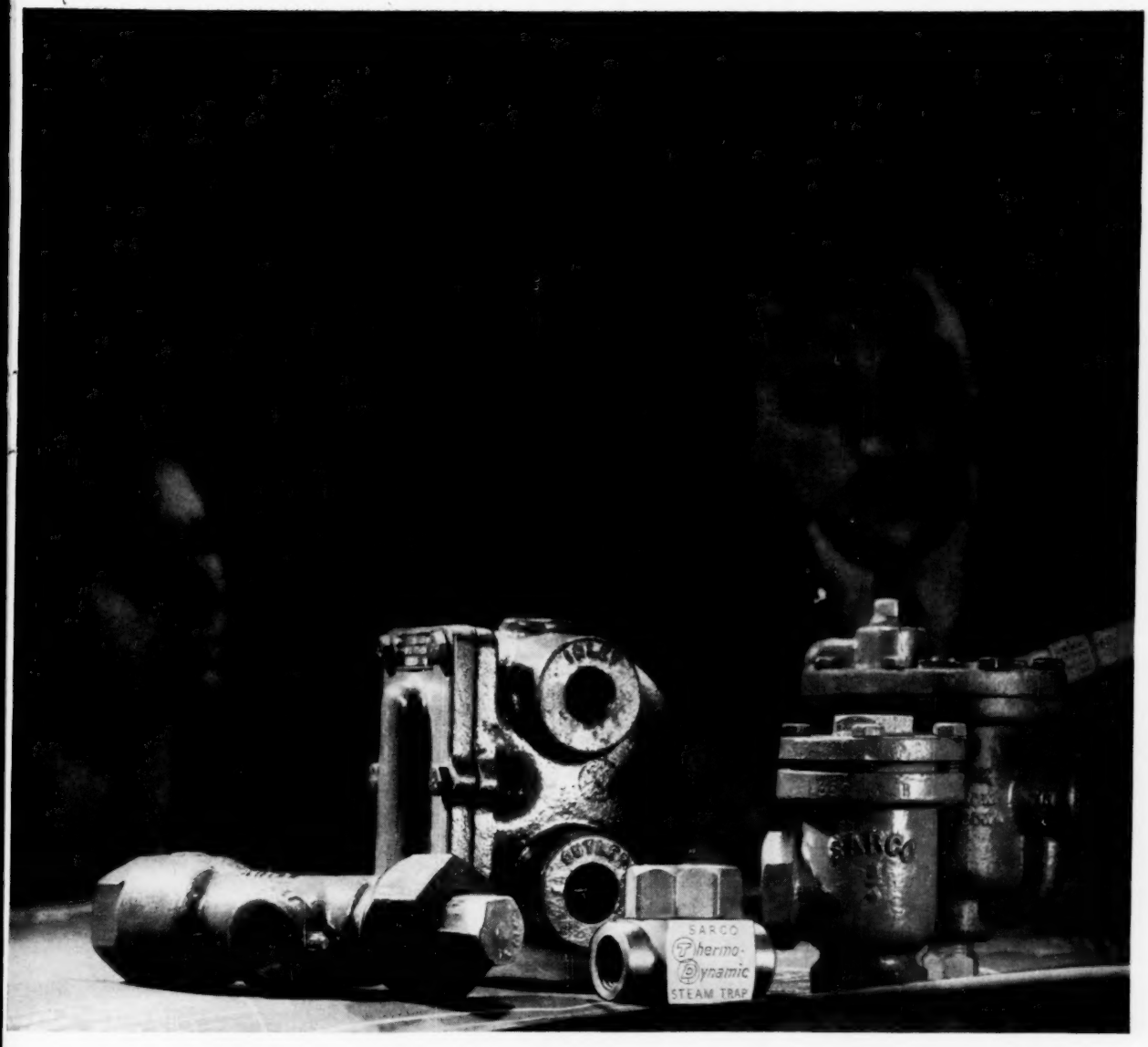
As the two illustrations above show, correct application of steam traps is as necessary as using the right trap. In the hook-up on the left, the lack of a condensate collection point plus the long leg to the trap will result in condensate's flowing past the drain point, possibly causing water hammer. The correct way to install the trap is shown at right, placed close to the drain point. A *strainer* should be placed before *any* trap to prevent entrance of scale or other foreign matter into the trap.

This is just one example of the way your Sarco representative can help you plan your steam system for maximum production.

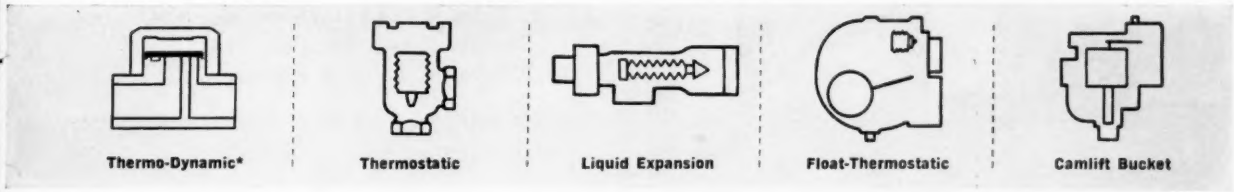
Traps must be matched to job for best system performance

No single type of steam trap will perform well in all applications. Each type has a range of applications for which it is best suited. For optimum efficiency these differences must be taken into account; traps must be chosen for their operating principles as well as their size and pressure rating.

Sarco can give you impartial help in selecting traps because only Sarco makes the five basic types. With Sarco, it's simple—one source, one responsibility, for all your trapping needs.



Only Sarco makes these five basic types of steam traps



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Take these two steps to Production-Planned steam trapping:

(1) Write today for Sarco literature; (2) Talk with your Sarco representative. He can help you check your trapping requirements, and he has—or will quickly get—the right answer to any unusual trapping problem.

*T.M.U. Pat. No. 2,817,353.

SARCO

COMPANY, INC.

635 Madison Ave., New York 22, N. Y.

STEAM TRAPPING • AIR VENTING • TEMPERATURE CONTROLS • HEATING SPECIALTIES

If You process SLURRIES, Let Sharples Advanced

Sharples 1958 Model Continuous Centrifuges are designed to give you the big edge in economical processing to meet today's competitive market conditions... and tomorrow's as well.

Sharples advanced design centrifuges set new standards of performance, flexibility of operation and range of capacity.

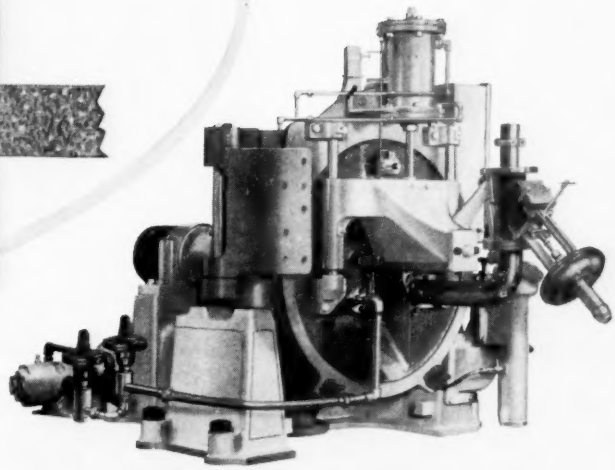
There are many specific facts that warrant the close scrutiny of those to whom the purchase of new plant equipment must be an outstandingly profitable capital investment.

Compare the new Sharples 1958 lines with the best you have experienced heretofore—and be convinced.

Sharples 1958 Nozljectors—A series of nozzle type disc bowl centrifuges with feed capacities up to 400 gallons/minute; up to 125 HP drive.

SLUDGES or CRYSTALS Design Work for You . . .

Sharples 1958 Super-D-Canters—Models for dewatering solids at feed rates as low as 1 gpm up to 250 gpm; solids discharge rates from below 25 lbs./hr. to approx. 12 tons/hr.



Sharples 1958 Super-D-Hydrators—A line of high efficiency crystal dehydrators with capacities ranging from 1 to 2 tons of crystals/hr. up to 20 tons or more/hr.

SHARPLES

THE SHARPLES CORPORATION

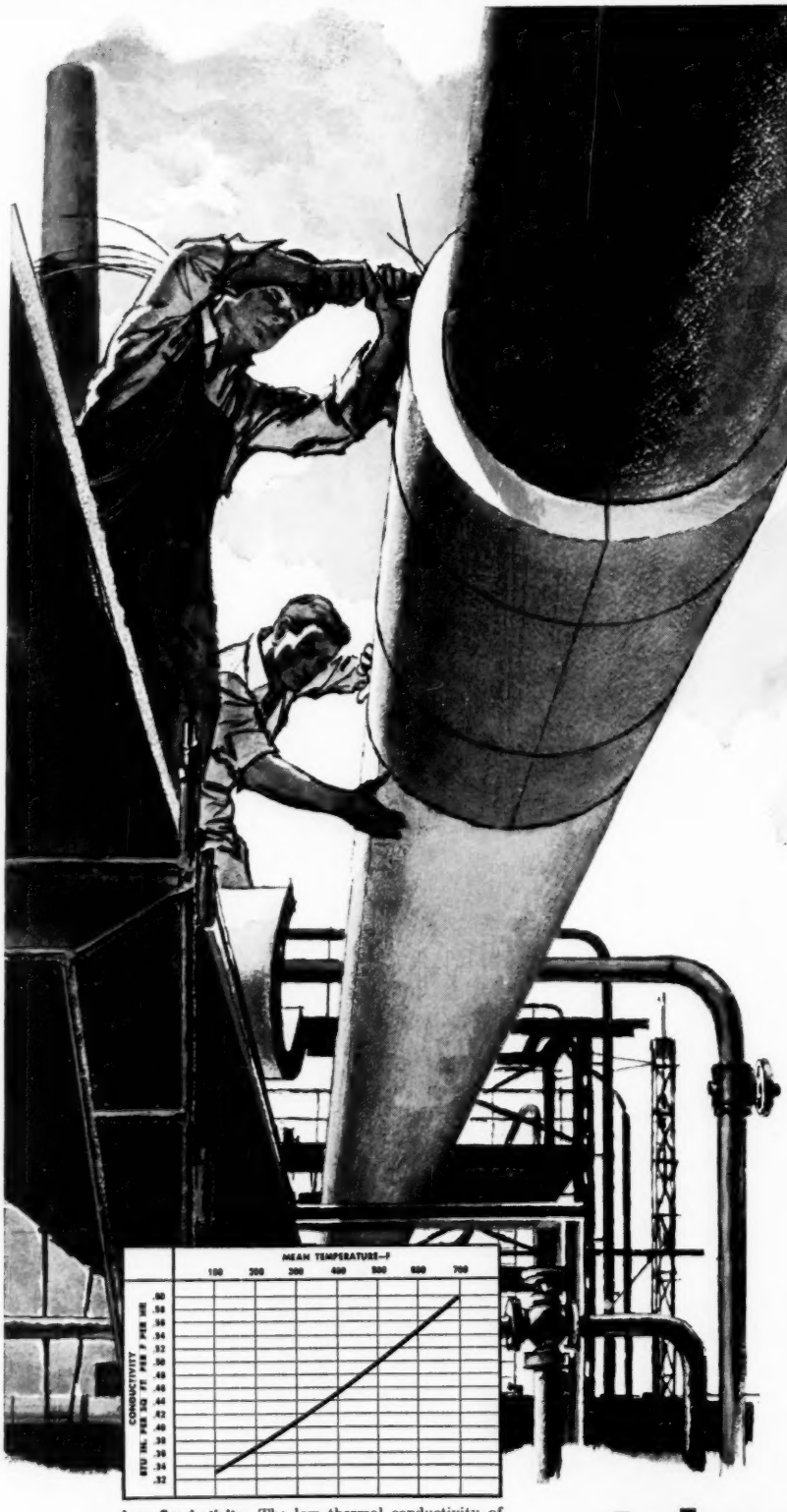
2300 WESTMORELAND STREET • PHILADELPHIA 40, PENNSYLVANIA

NEW YORK • PITTSBURGH • CLEVELAND • DETROIT • CHICAGO • NEW ORLEANS • SEATTLE • LOS ANGELES • SAN FRANCISCO • HOUSTON

Associated Companies and Representatives throughout the World

In developing THERMOBESTOS Insulation

J-M at



Low Conductivity. The low thermal conductivity of Thermobestos is best demonstrated in actual service where it makes possible accurate, uniform temperature control, helps reduce fuel costs and contributes materially to operating efficiency.

Not damaged by water. Thermobestos has the moisture resistance outdoor service demands. Soak it in water for one day or 365—and you can still walk on it without damage. Dry it out and Thermobestos is as good as new, with conductivity and structural strength unimpaired.

Johns-Manville

for outdoor process industry applications

research scientists didn't stop top insulating effectiveness...

They added the three physical properties you most wanted— HIGH STRENGTH—LIGHT WEIGHT —MOISTURE RESISTANCE!

Thermobestos® offers the lowest k factor of all insulations in general use throughout the process industries. For maximum heat control on outdoor piping and equipment operating at temperatures to 1200F it just can't be beat!

Yet top insulating effectiveness is only one reason why more and more engineers are specifying Thermobestos for refineries, chemical plants, and wherever hot outdoor vessels and piping must be insulated. For Thermobestos also offers a threefold bonus . . .

. . . Three outstanding physical properties

Thermobestos is 1) strong and rigid. Its hard composition resists crushing and easily withstands unusual service abuse. Yet it is 2) lightweight for easy handling and fast application. And it is 3) highly moisture resistant, remains undamaged even by prolonged wetting.

Quickly, easily applied

Thermobestos is made from hydrous calcium silicate . . . molded to size for proper fit. Its high strength makes it particularly adaptable for time-saving shop prefabrication of fittings and bends.

Furnished in large sections, Thermobestos is easy to apply. It reduces the number of joints. In pipe insulation form, it comes in a complete selection of sizes up to 30″ O. D. Also available in 6″ x 36″ and 12″ x 36″ blocks in a full range of thicknesses.

For further information write for your free copy of the 12-page Thermobestos booklet, IN-169A. Address Johns-Manville, Box 14, New York 16, N. Y. In Canada, Port Credit, Ontario.

INSULATIONS FOR LASTING THERMAL EFFICIENCY
MATERIALS · ENGINEERING · APPLICATION

JOHNS-MANVILLE JM PRODUCTS

ANOTHER IN A SERIES
OF MOTOR FACTS
FROM ALL INDUSTRIES

Westinghouse Life-Line "A" motors helped save $13,500 in olive pitting operation . . .

at Bell Packing Corporation, Berkeley, California

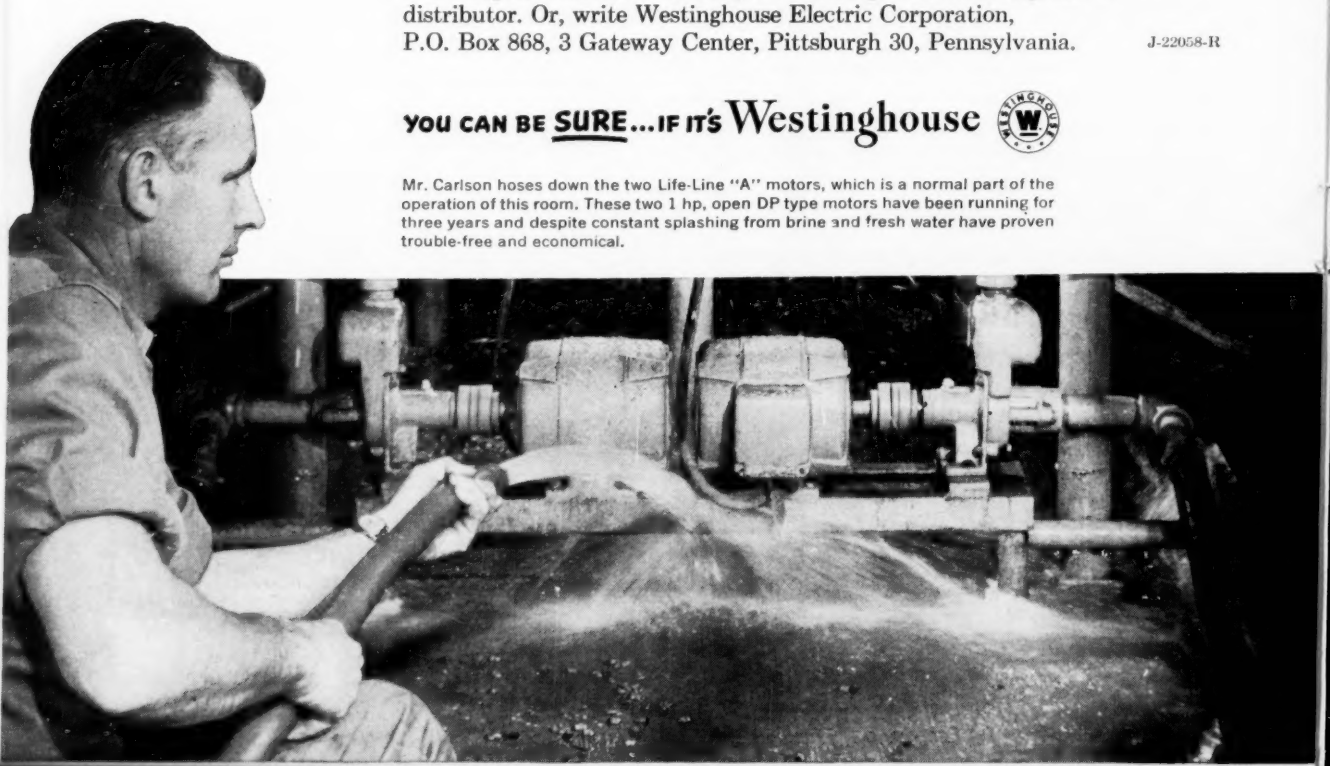
Continuously driving brine pumps for olive-pitting operation, Westinghouse motors have helped cut production costs, improved product quality

"Westinghouse Life-Line® 'A' motors make possible the profitable functioning of the new pitting room in our olive canning plant," states Mr. William Carlson, Plant Superintendent at Bell Packing Corporation, Berkeley, California.

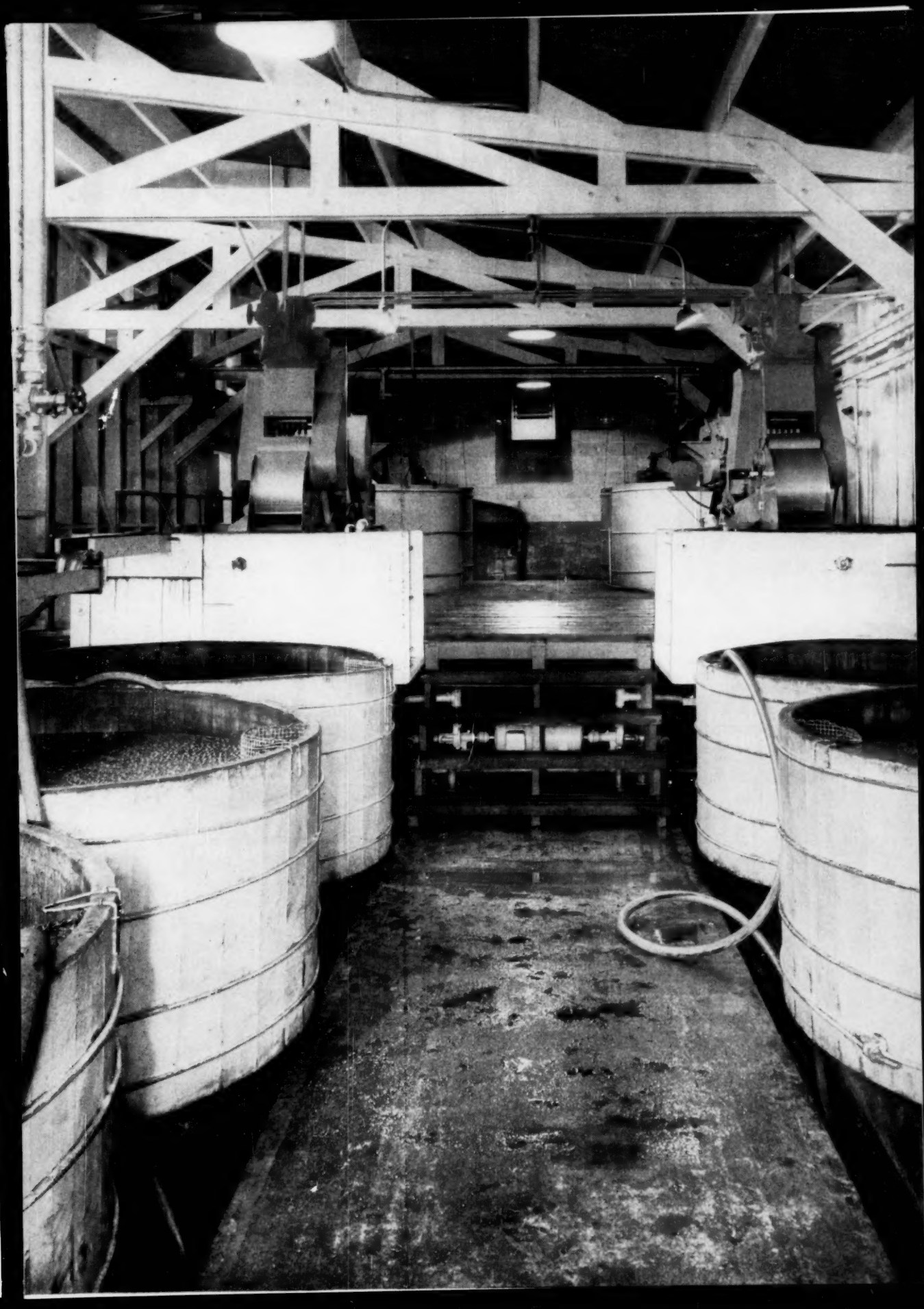
Mechanizing this operation has increased production 15% and released a good share of the normally required manpower for use elsewhere in the plant. In three years, Bell Packing reports a saving of $13,500. In designing the area, Bell Packing Corporation considered the choice of motors for the brine pumps the most serious problem. Westinghouse 1 hp Life-Line "A" motors were chosen on their record of long-term, trouble-free life under the toughest conditions.

POWER-UP with the motor designed to meet modern industry's needs. For complete information, call your Westinghouse sales engineer or distributor. Or, write Westinghouse Electric Corporation, P.O. Box 868, 3 Gateway Center, Pittsburgh 30, Pennsylvania. J-22058-R

YOU CAN BE SURE...IF IT'S Westinghouse



Mr. Carlson hoses down the two Life-Line "A" motors, which is a normal part of the operation of this room. These two 1 hp, open DP type motors have been running for three years and despite constant splashing from brine and fresh water have proven trouble-free and economical.



NEW! AAF model B

GALVANIZED METAL MINIMIZES CORROSION!
NEW FOOL-PROOF OPERATION–SIMPLIFIED MEDIA FEED!
REINFORCED MEDIA! IMPROVED ADHESIVE!
GREATER CFM PER UNIT! MORE FILTERING AREA!
NEW MEDIA SUPPORTS ADD STRUCTURAL STRENGTH TO FRAME!
LESS MAINTENANCE TIME REQUIRED!
NOW ONE DRIVE WILL SERVE SIX UNITS!

Roll-O-MATIC® AIR FILTER!

RETAINS *ALL* THE FEATURES of the amazing AAF Roll-O-Matic that have led to installation of thousands of sections at 2,100 locations since 1954—totalling more than 100 million cfm!

- Clean air by the roll!
- As simple to service as a roll-fill camera!
- Infrequent maintenance!
- No oil or water for washing!
- High cleaning efficiency!
- Large dust-holding capacity!
- Fully automatic!
- Simple disposal of used media!
- Notifies operator when needing attention!
- Low power requirements!

and offers *these* big IMPROVEMENTS

✓ **Stronger MEDIA!** Unique Roll-O-Matic filtering media is now reinforced for greater strength. New adhesive (1) won't "run" in high temperatures, (2) won't thicken in low temperatures, and (3) won't lose adhesive qualities due to dryness.

✓ **Simpler OPERATION!** Positive drive for introducing new media and re-winding used media. Minimum of moving parts.

✓ **Easier MAINTENANCE!** Non-corrosive frame, simpler operation, stronger media, better adhesive, re-location of drive all add up to fewer maintenance headaches.

✓ **Greater CFM!** Now, more media area, more CFM per filter! New design provides maximum effective filtering area per unit.

✓ **Rugged, heavy-duty DRIVE!** Drive is now on service side of unit for easier accessibility. Fractional hp. drive will serve six units of maximum standard height and width. Means big savings in first cost, installation, and operation.

✓ **Corrosion-resistant CONSTRUCTION!** The Model B Roll-O-Matic is constructed of galvanized metal . . . minimizes corrosion problem. New media supports add to structural strength of frame in addition to serving as media guides.

WRITE TODAY FOR NEW ROLL-O-MATIC BULLETIN 248-C!

AAF Filters and Precipitators

Herman Nelson Propeller Fans

AAF herman nelson

American Air Filter
COMPANY, INC.

326 Central Avenue, Louisville 8, Kentucky
American Air Filter of Canada, Ltd., Montreal, P. Q.

BETTER AIR IS OUR BUSINESS

Illinois Heating Specialties

AAF DUST Control Equipment

Big-tonnage refrigeration news...

Carrier

CENTRIFUGAL COMPRESSORS

with broad application flexibility
now in increased capacities up to

3000 tons

Now, the big-tonnage refrigeration requirements for many large chemical and petroleum processing applications can be handled economically with a single Carrier Centrifugal Compressor. These multi-stage, heavy-duty centrifugals are designed and built to the same high-quality standards that have earned Carrier the reputation for around-the-clock dependability on thousands of applications.

With unit capacities up to 3000 tons, these Carrier Centrifugal Compressors provide many installation and operating advantages. To mention a few:

Extreme flexibility of arrangement with coolers and condensers. Four of many combinations are illustrated.

High lift or wide temperature range in two, three or four stages.

Side loading for split load requirements.

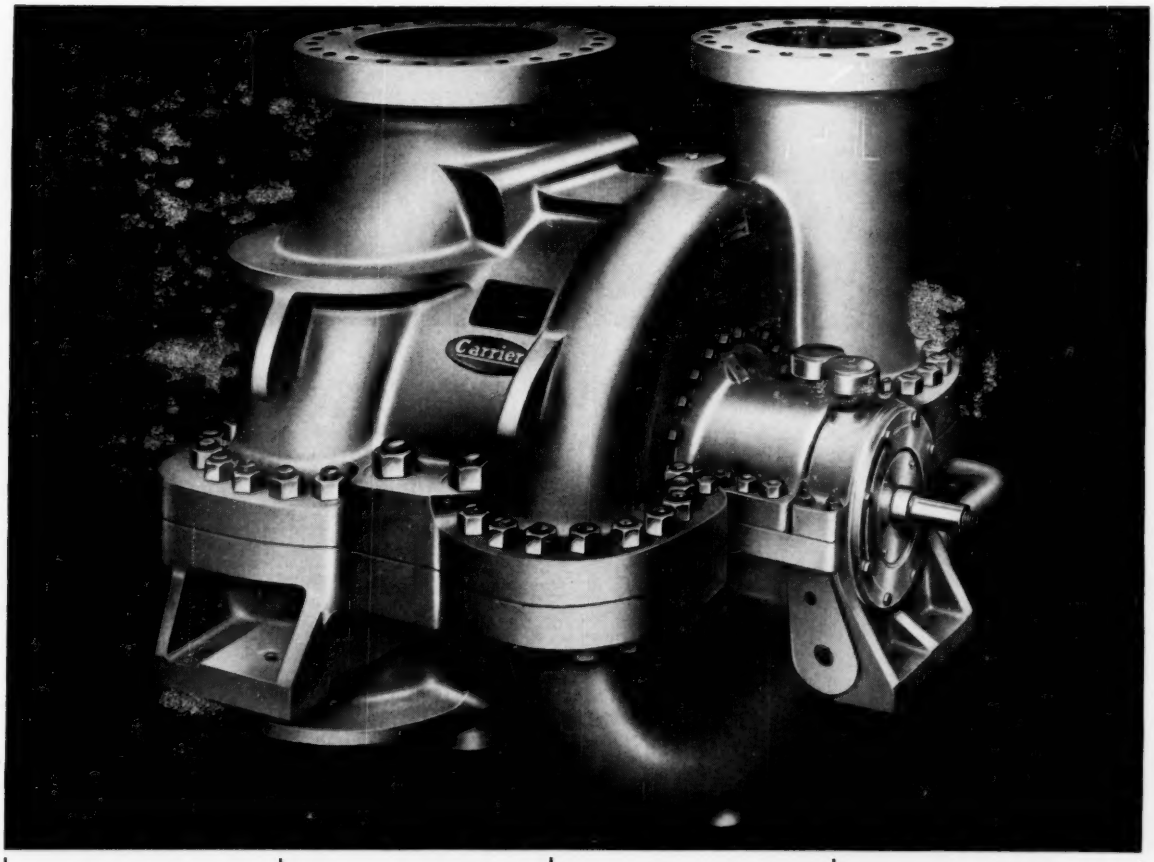
Variable inlet guide vanes for capacity control.

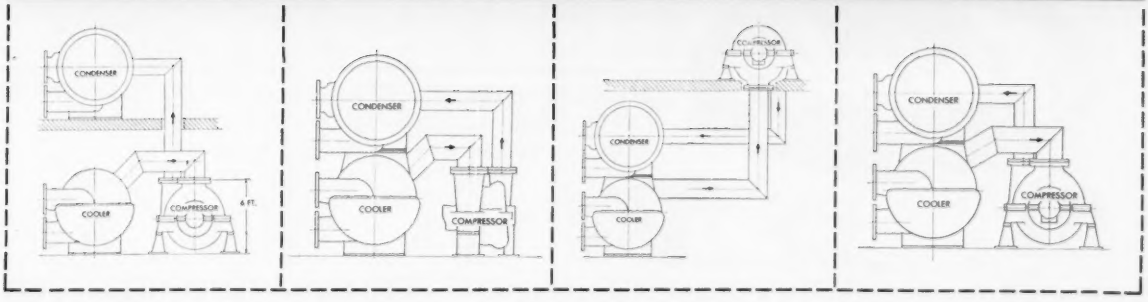
Suitable for all types of drives.

Versatile use with any high-pressure refrigerant.

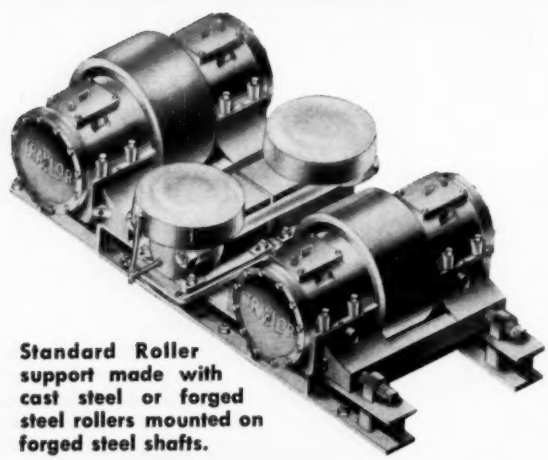
Whatever your requirements, the Carrier specialist in your area can make an impartial recommendation. For information about these big-tonnage Carrier Centrifugals and specific application to your requirements, call your nearest Carrier office, or write

CARRIER CORPORATION, SYRACUSE, NEW YORK





Traylor-MADE ROTARY KILNS



Standard Roller support made with cast steel or forged steel rollers mounted on forged steel shafts.

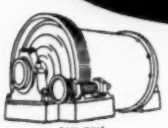
One of the many advantages of Traylor-made Rotary Kilns is the Traylor Roller Supports. These insure easy alignment, continuous operation and low maintenance of Traylor Kilns, Coolers, Dryers and Slakers. Hundreds of Traylor Rotary Kilns in daily use reflect the soundness of design and high standards developed by Traylor craftmen with over fifty years of experience. The name Traylor is your guarantee of the highest quality machinery made. For more information on Traylor Kilns write for bulletin #1115 today.

Traylor

TRAYLOR ENGINEERING & MFG. CO. 1040 MILL ST., ALLENTOWN, PA.

Sales Offices: New York — Chicago — San Francisco

Canadian Mfr.: Canadian Vickers, Ltd., Montreal, P. Q.


BALL MILLS

ROTARY KILNS

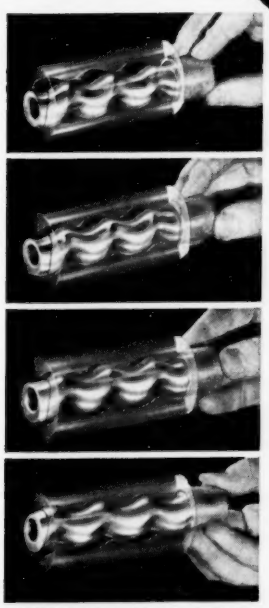
APRON FEEDERS

PRIMARY GYRATORY CRUSHERS

JAW CRUSHERS

SECONDARY GYRATORY CRUSHERS

MOYNOS®
SLASH PUMP MAINTENANCE COSTS



PROGRESSING CAVITY PRINCIPLE
A screw-like rotor revolves in a double threaded helical stator creating smoothly moving cavities.

Moynos pump "problem" chemicals that ruin other pumps!

Moyno Pumps have increased production and greatly lowered downtime on many chemical jobs where they replaced other type pumps which had run up prohibitive maintenance costs or failed completely.

Moynos can pump any chemical that can be forced through a pipe, whether a thin watery slurry or an extremely viscous material like rubber dough. A rugged screw-like rotor turning inside a double threaded stator forms "progressing cavities" which move chemicals smoothly. Fluids are pumped without turbulence or agitation. Discharge is uniform, nonpulsating.

Moynos last longer on tough chemical duty because the rotor and stator can be made of special materials that resist the tortures of abrasion and corrosion. Moynos need few or no repair parts . . . show little wear, even after long service.

If you are moving chemicals by hand or other expensive means because they're considered "unpumpable" . . . or if you want to decrease present pumping costs on "problem" chemicals, send us an outline of your problem today. Write for your free Moyno Pump Bulletin 30-CE.

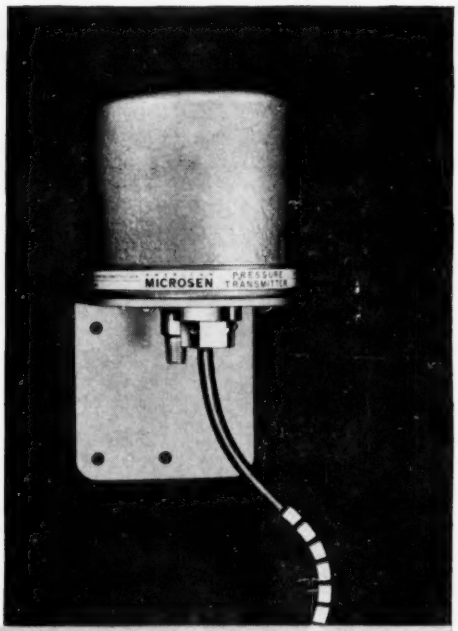
ROBBINS & MYERS, INC.

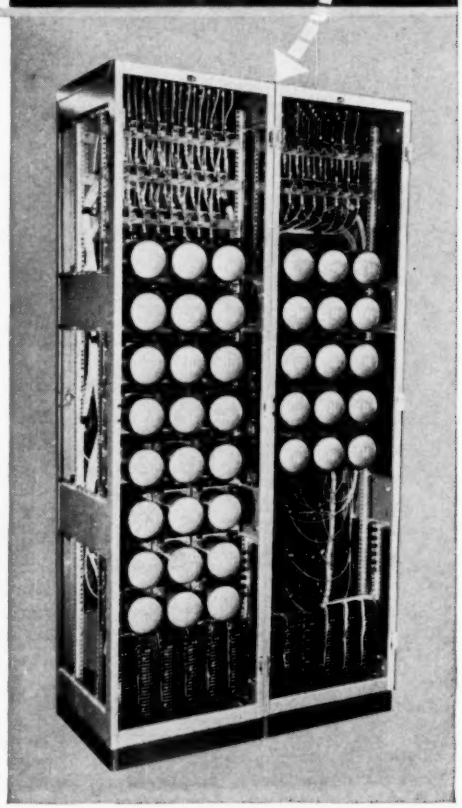
SPRINGFIELD, OHIO / BRANTFORD, ONTARIO

MOTORS · FANS · HOISTS · MOYNO® PUMPS · (INDUSTRIAL) PROPELLAIR® FANS

NOW... a compact ELECTRO-PNEUMATIC PRESSURE TRANSDUCER

for data reduction systems





The American-Microsen® Series 185 Pressure Transducer is designed to convert pressure signals to dc signals for use with data handling, telemetering or computer equipment. It can be supplied with input ranges from 0-15 psi up to 0-1000 psi; also 3-15 psi to transduce pneumatic signals.

The Series 185 Pressure Transducer converts pressure signals to 1.0 to 5.0 ma. dc which is readily accepted by data handling systems. Sensitivity of the unit is practically infinite. It has a repeatability of 0.3% of span; speed of response is 10 cps.

Use of the Microsen Balance enables the transducer to transmit signals instantaneously over long distances. An external power supply is employed which can be filtered to provide a high signal-to-noise ratio as required in high speed data handling equipment.

Housed in a dust and weatherproof case for universal mounting, the Series 185 Pressure Transducer can be installed on a vertical surface, pipe pedestal or meter piping. It is also readily adaptable to rack mounting as shown at the right. Get detailed information. *Write for Bulletin TP515.*

MAXWELL MM&M MANNING & MOORE INC. TRADE MARK

MANNING, MAXWELL & MOORE, INC.

INDUSTRIAL CONTROLS DIVISION · DANBURY, CONNECTICUT

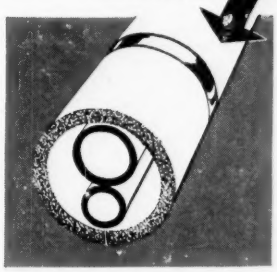
MAKERS OF 'AMERICAN-MICROSEN' ELECTRONIC INSTRUMENTS FOR MEASUREMENT, TRANSMISSION AND CONTROL

Now! One-pipe steam-traced systems with new Reynolds Aluminum Duplex Pipe with steam line built-in.

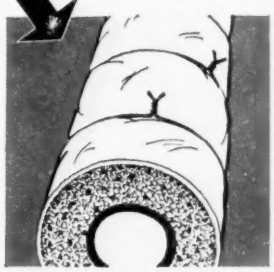
THIS ELIMINATES

THESE UNNECESSARY COSTS:

...the cost of steam jacketing and extra pipe



...the cost of excessive insulation



Now a complete steam-traced system can be installed in one pipe: Reynolds new Aluminum Duplex Pipe.

This tough, lightweight pipe has a *built-in* steam line . . . it eliminates the need for steam jacketing . . . it eliminates outside steam-trace lines . . . it permits use of standard insulation . . . it's a complete steam-trace system in one pipe.

Installation is fast and simple, too, with Reynolds Duplex Pipe. It's lightweight and easy to handle, join and weld, and can be formed readily with ordinary hydraulic pipe bending equipment.

The new Reynolds Duplex Pipe can improve heating efficiency, and reduce the need for insulation. Aluminum has high thermal conductivity, low emissivity. This means better heat transfer within the Duplex Pipe, less heat lost, less insulation needed.

And, like the Reynolds Aluminum Process Pipe that is handling the roughest jobs in the chemical processing and petroleum industry, the new Duplex Pipe stands up against corrosion.

Reynolds Duplex Pipe is available in four sizes —1½", 2", 3" and 4"—and in alloys 3003-F, and 6063-T5.

Get full information on Reynolds Duplex Pipe

FREE BROCHURE

Write today for a free brochure on Reynolds Aluminum Duplex Pipe, for details on joining, sizes, alloys and pressure ratings. *Reynolds Metals Company, P.O. Box 1800- CJ, Louisville 1, Kentucky; International Division, 19 East 47th Street, New York 17, New York.*

Watch Reynolds All-Family Television Program, "DISNEYLAND", ABC-TV.

Keeping Hooker Cells at their best

Making the best use of the remarkable efficiency of Hooker cells depends upon the skills of the men who operate them.

Also at work, with a skill all their own, are GLC ANODES, which are "custom made" to individual cell requirements.

FREE – *This illustration of keeping cells at peak efficiency has been handsomely reproduced with no advertising text. We will be pleased to send you one of these reproductions with our compliments. Simply write to Dept. N-5.*

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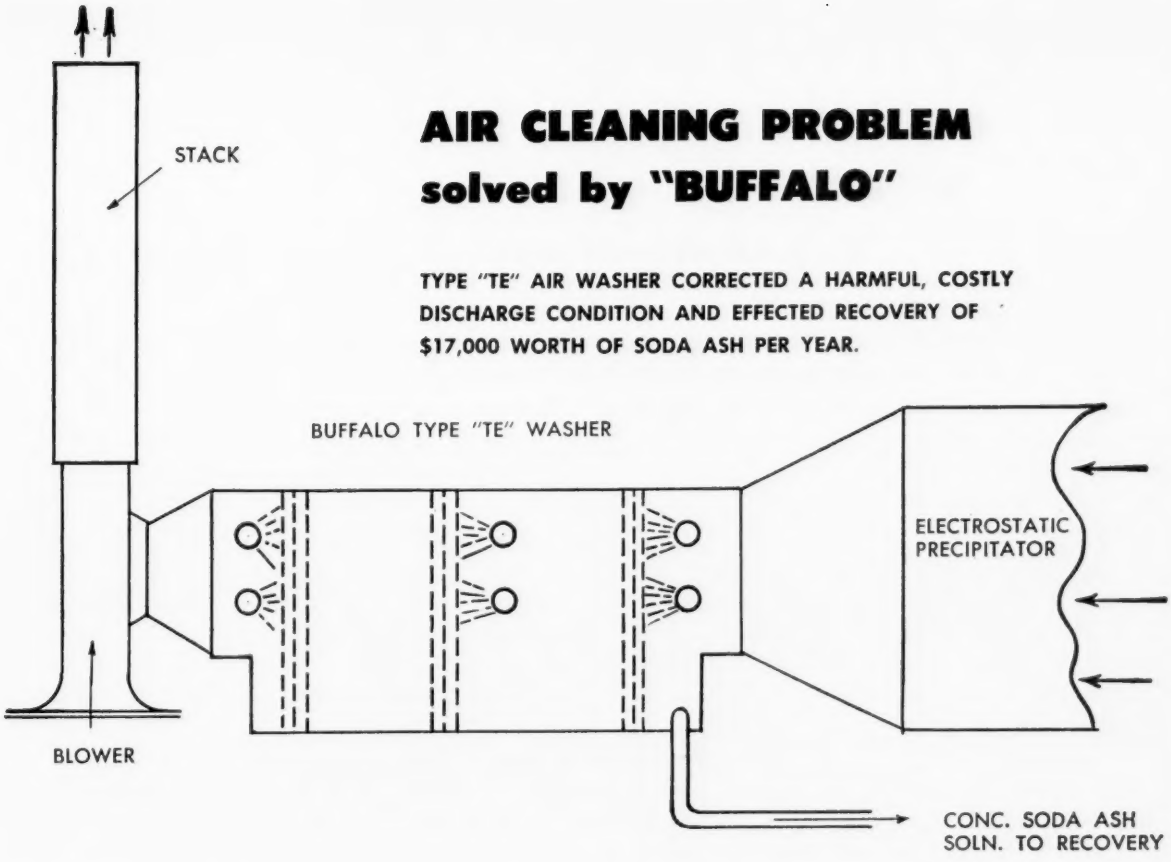
DIVISION

GREAT LAKES CARBON CORPORATION

18 EAST 48TH STREET, NEW YORK 17, N.Y. OFFICES IN PRINCIPAL CITIES

AIR CLEANING PROBLEM solved by "BUFFALO"

TYPE "TE" AIR WASHER CORRECTED A HARMFUL, COSTLY DISCHARGE CONDITION AND EFFECTED RECOVERY OF $17,000 WORTH OF SODA ASH PER YEAR.



PROBLEM

A paper firm was suffering poor community relations due to a soda ash discharge from its recovery plant. The ash, flaking off the collecting plates of its large electro-static precipitator, was damaging auto finishes.

SOLUTION

Installation of a "Buffalo" 84,000 cfm Type "TE" Washer as shown. Washer is all-stainless construction, with two wet scrubbing stages and one eliminator stage. Scrubbing water was recirculated thru spray nozzles at 20 psi until soda ash became concentrated enough for efficient collection.

RESULTS

Nuisance to neighbors was eliminated. Inlet soda ash loadings ranging from .13 to .43 grains/cu. ft. were reduced to between .02 and .09 grains at outlet for a collection efficiency average of 88.2%. 500 tons of soda ash are recovered each year in continuous service between annual maintenance shutdowns.

WHAT'S YOUR AIR CLEANING PROBLEM?

Whatever the contaminant, whatever the removal problem, chances are excellent that a "Buffalo" Unit is controlling a similar condition in your industry to complete satisfaction. Write for details today — take advantage of our long experience in industrial air cleaning.

"Buffalo"

VENTILATING	AIR CLEANING	AIR TEMPERING
INDUCED DRAFT	EXHAUSTING	FORCED DRAFT
COOLING	HEATING	PRESSURE BLOWING

Using Salt Efficiently

by INTERNATIONAL SALT COMPANY, INC.

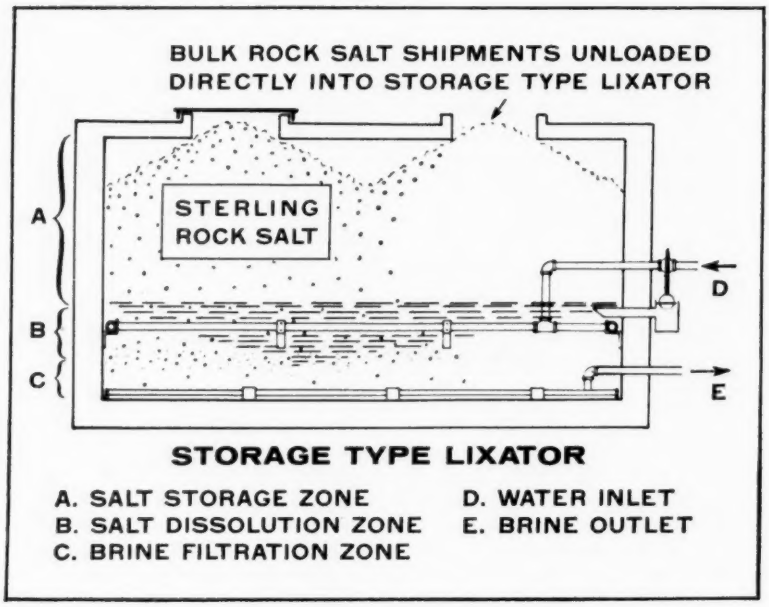
Producing Crystal-Clear Brine at Lowest Cost—by Self-Filtration

Today, more and more companies are using a foolproof brine-making process that produces crystal-clear brine from rock salt, *without using supplemental filter beds or other filtering devices.* This process takes place in the "Sterling Lixator," a rock-salt dissolver developed exclusively by International Salt Company. Operating on International's principle of self-filtration, the Lixator produces a rock-salt brine so high in purity and so brilliantly clean and clear that it can be used in many operations formerly thought to require highly refined evaporated salt.

Here, briefly, is how self-filtration works in the Sterling Lixator: A Lixator is filled with Sterling Rock Salt. Water, admitted near the top, dissolves salt as it flows downward. While flowing down, the brine made in this way becomes fully saturated, and can dissolve no more salt. Still flowing down, this brine is *completely filtered* by the salt-crystal bed in the bottom portion of the Lixator. Thus, the Lixate Brine drawn off through a discharge pipe at the bottom of the Lixator is clean, pure, crystal-clear—and the only source of power used is gravity, which costs nothing!

Other Lixator advantages. In addition to this superbly clean, fully saturated Lixate Brine, a number of other advantages are yours, when you use a Lixator:

- The Lixator permits salt storage and brine making at one location most convenient to the point of salt entry. *Pipes* deliver brine to points of use.
- Because Lixate Brine is piped to points of use, the work of moving dry salt from storage piles to other plant locations is eliminated. This can produce substantial savings in labor.
- The Lixator *automatically* controls salt feed, water feed, and brine discharge. Rapid, uniform brine production is maintained constantly, because in the Lixator there is no bridging, caking, or channeling.



The Storage Lixator — designed for larger operations. This is a combination salt storage tank and dissolving tank. On delivery, rock salt is unloaded directly into the Storage Lixator. The rest is automatic.

Many types of Lixators are available from International Salt Company. In addition to Storage Lixators, there are Silo Lixators and Sterling Model Lixators—in numerous designs to suit any plant layout. And every Lixator operates on the economical self-filtration principle.

For expert advice on the particular Lixator type that will do the best job for you, phone or write the nearest district sales office, or write to us direct. One of our sales engineers will gladly show you how this remarkable brine-making equipment can help you use salt most efficiently and economically.

Using salt efficiently in its many industrial applications calls for technical knowledge and experience. International Salt Company has both. Plus a continuing program of research and development in salt. These things can be put to work for you, in your plant, to help you get the most out of the salt or brine you use.

* * *

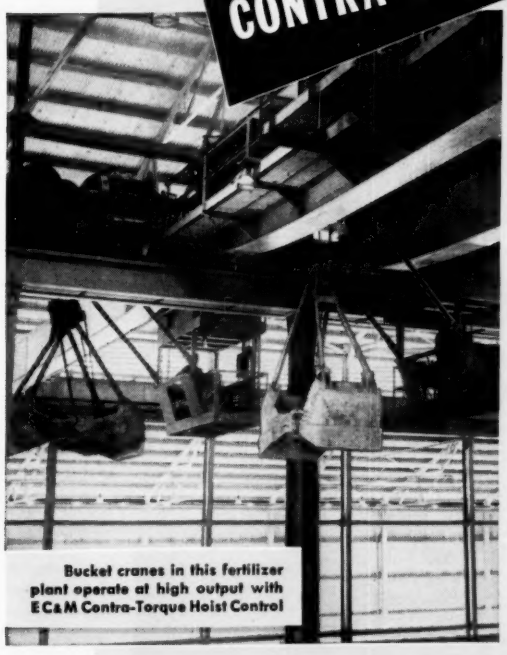
INTERNATIONAL SALT CO., SCRANTON, PA.

Sales Offices: Atlanta, Ga.; Chicago, Ill.; New Orleans, La.; Baltimore, Md.; Boston, Mass.; Detroit, Mich.; St. Louis, Mo.; Newark, N. J.; Buffalo, N. Y.; New York, N. Y.; Cincinnati, O.; Cleveland, O.; Philadelphia, Pa.; Pittsburgh, Pa.; Memphis, Tenn.; and Richmond, Va.

Service and research are the extras in **STERLING SALT**

PRODUCT OF INTERNATIONAL SALT COMPANY, INC.

Bucket crane of the Level-Luffing type operates speedily under EC&M Contra-Torque Hoist Control



Bucket cranes in this fertilizer plant operate at high output with EC&M Contra-Torque Hoist Control

EC&M

HERE'S HOW EC&M FREQUENCY RELAY CONTROL improves A-C Bucket Crane performance

CONTRA-TORQUE®

FAST GETAWAY! Quickly responsive to the frequency of the induced-rotor voltage, EC&M FREQUENCY RELAYS match torque requirements to the load. They get the motor up to speed quickly for lowering the bucket and moving the trolley in or out. A lot of time saved between trips!

WIDE SPEED SELECTION! These relays permit pick-up of Contra-Torque lowering connections on any master switch speed point. No waiting until last down point is reached. Wider choice of speed gives greater flexibility in clean-up operations and speeds output!

SMOOTH STOPPING ELECTRICALLY! *Off-point braking** brings the descending load to rest and the magnetic brake sets to hold the load. Electrical braking has practically eliminated holding brake wear on many cranes now equipped with this feature.

SPEED-LIMITING! Safety on all speeds. These relays (one set for hoisting and lowering) automatically shift motor connections to safeguard lowering operation with far greater skill than human hands.

***Off-point braking** to eliminate brake wear
—a new EC&M development for AC bucket cranes

THE ELECTRIC CONTROLLER & MFG. CO.
A DIVISION OF THE SQUARE D COMPANY
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14

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See how you simplify inventory and lower costs with the AO R-5000 Series Respirator. Interchangeable cartridges protect against a multitude of dusts, mists, vapors and fumes. *Write for literature today.*

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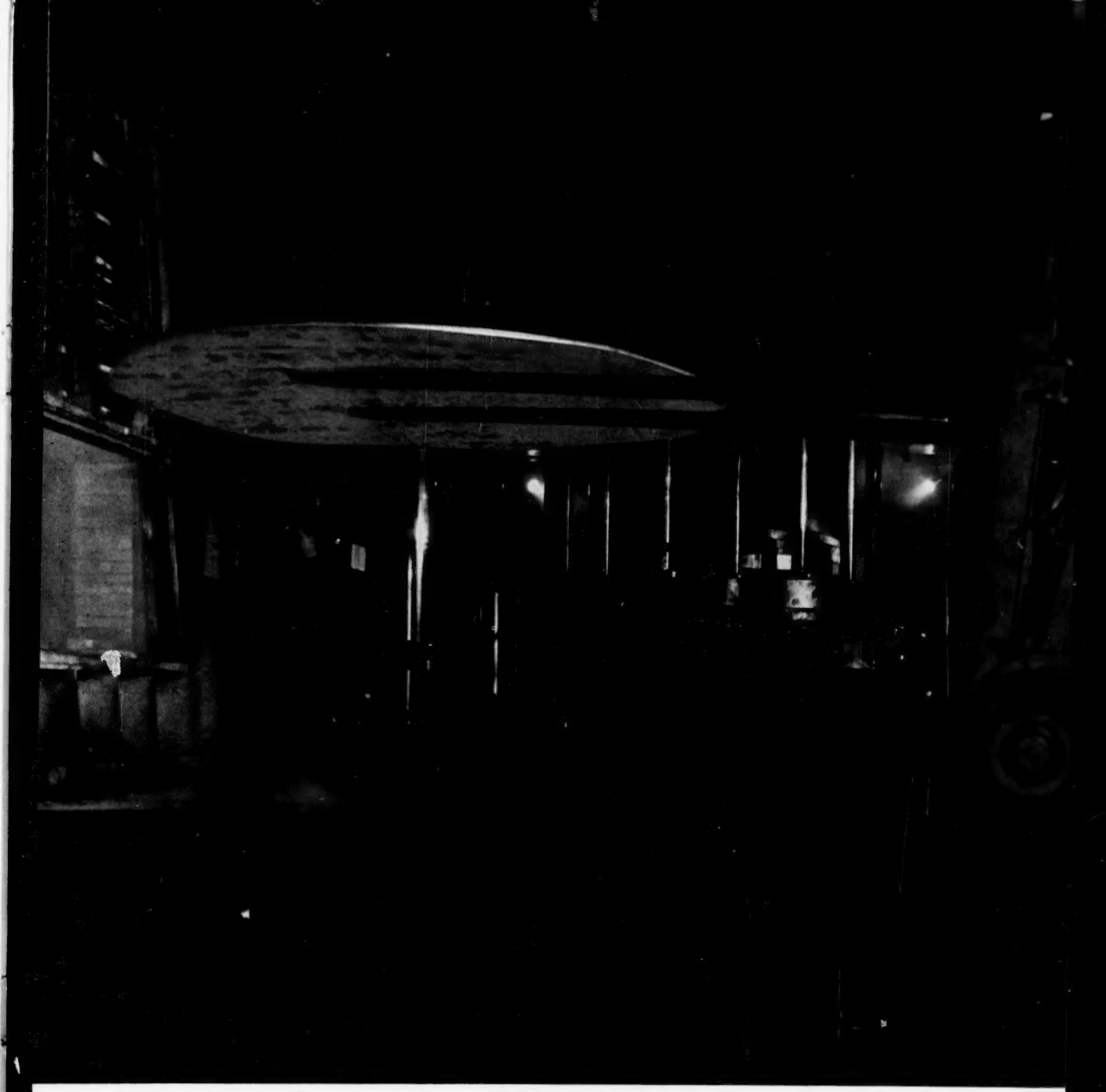

A hot steel circle ready for Claymont's 3000-ton head press. This precision machine is capable of hot or cold pressing heads up to 10 feet in diameter in a wide variety of metals. Integrated facilities make Claymont a reliable source of quality steel plate and plate products for industry.

by d'Arazien

CLAYMONT PRESSED HEADS

CF&I

CHECK CLAYMONT FOR—Alloy Steel Plates • Carbon Steel Plates • Stainless-Clad Steel Plates High Strength Low Alloy Steel Plates • CF&I Lectro-Clad Nickel Plated Steel Plates • Pressed and Spun Steel Heads • Manhole Fittings and Covers • Fabricated Steel Products Large Diameter Welded Steel Pipe

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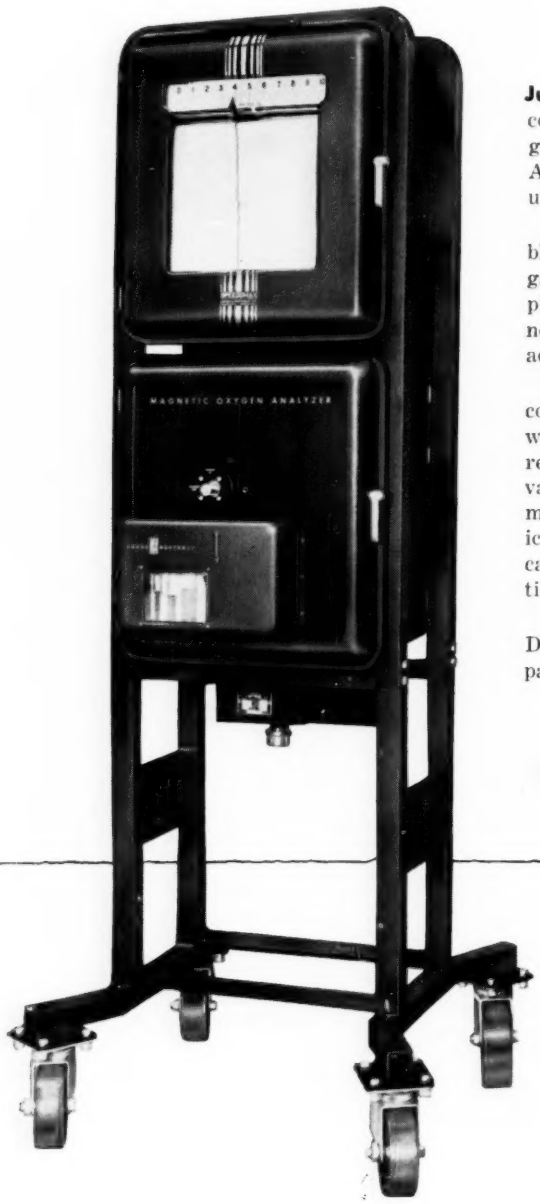

Just roll this Magnetic O_2 Analyzer Recorder up to any sample pick-off point and get continuously recorded excess air data. And it's accurate data, for complete measurement is by direct magnetic action.

Already, operators are using the assembly for many purposes . . . checking flue gas stratification, verifying regular sampling points, exploring the suitability of new sampling points, checking for burner adjustment.

This rugged assembly is designed for continuous day-after-day operation . . . works from any 115-volt, 60 cycle non-regulated power source . . . has its own vacuum pump and sample cleaning filters mounted on the rear . . . doesn't need chemical reactions or auxiliary gas supplies for calibration and operation . . . requires practically no set-up time.

For more details write for Preliminary Data Sheet 463-61. Leeds & Northrup Company, 4916 Stenton Ave., Phila. 44, Pa.

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Range	0 to 5% O_2, 0 to 10% O_2, or higher in flue gas as specified
Accuracy	0.15% O_2
Sensitivity	Better than ±0.05% O_2
Stability	Better than ±0.15% O_2
Response	Initial response at Analyzer, 4 sec.; to 90% of full scale at Analyzer, 30 sec. Typical sampling lag, 1 sec. per 6 ft. of ½" plastic tubing

The Rockwood Dualsteel Union was made especially to handle highly corrosive material

There's nothing to worry about

It's a ROCKWOOD DUALSTEEL UNION!

Rockwood's Dualsteel Unions stand up to wrench abuse and overcome galling. The reason — Dualsteel's greater Brinell hardness.

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But there are even more reasons why Rockwood Dualsteel Unions are what you're looking for. All Dualsteel Unions are individually air tested under fluid. Their ultimate strength is 85,000 pounds per square inch.

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Please send me prices and further data on the Rockwood Dualsteel Unions.

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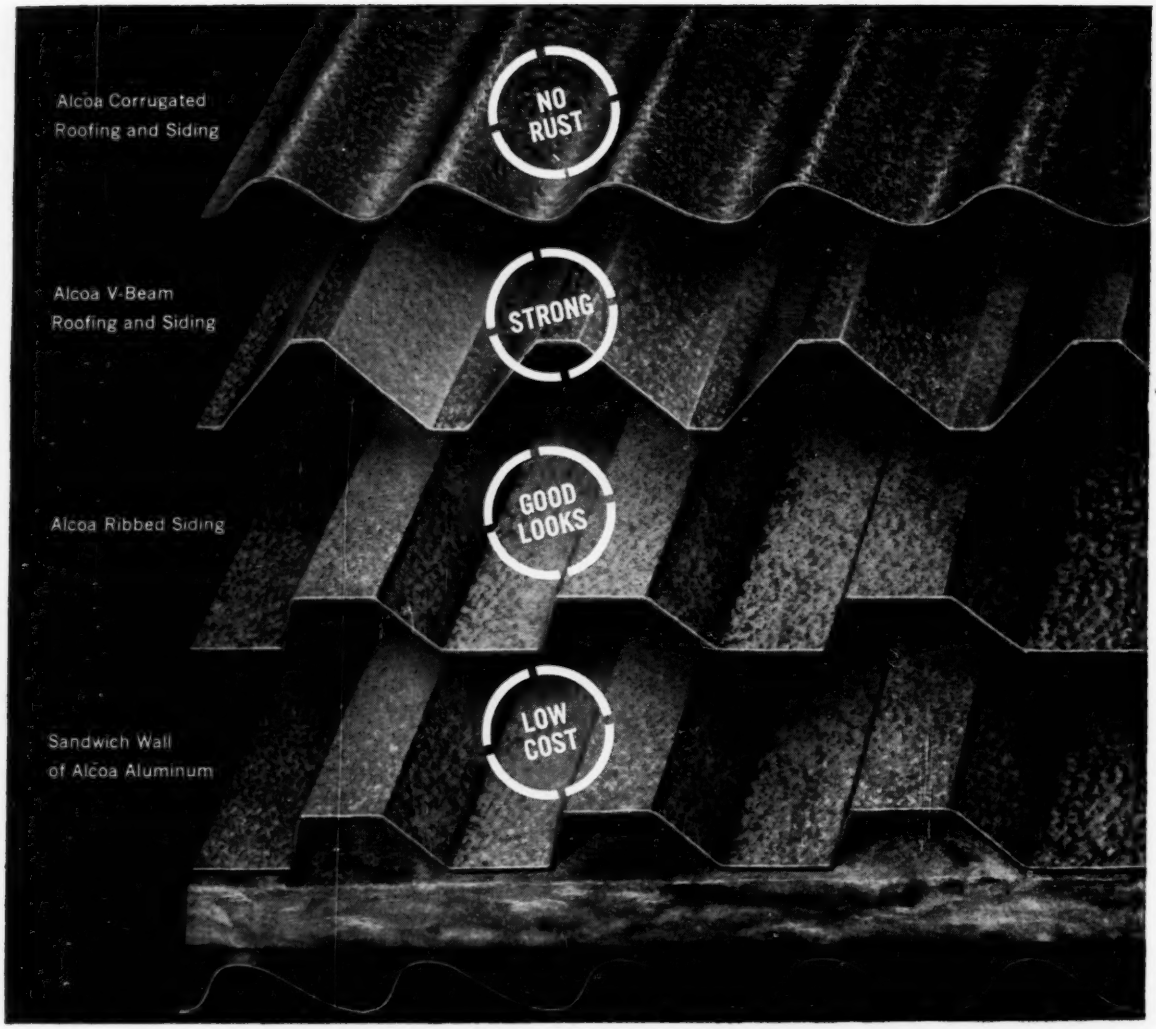
Title.....

Company.....

City.....Zone..State.....



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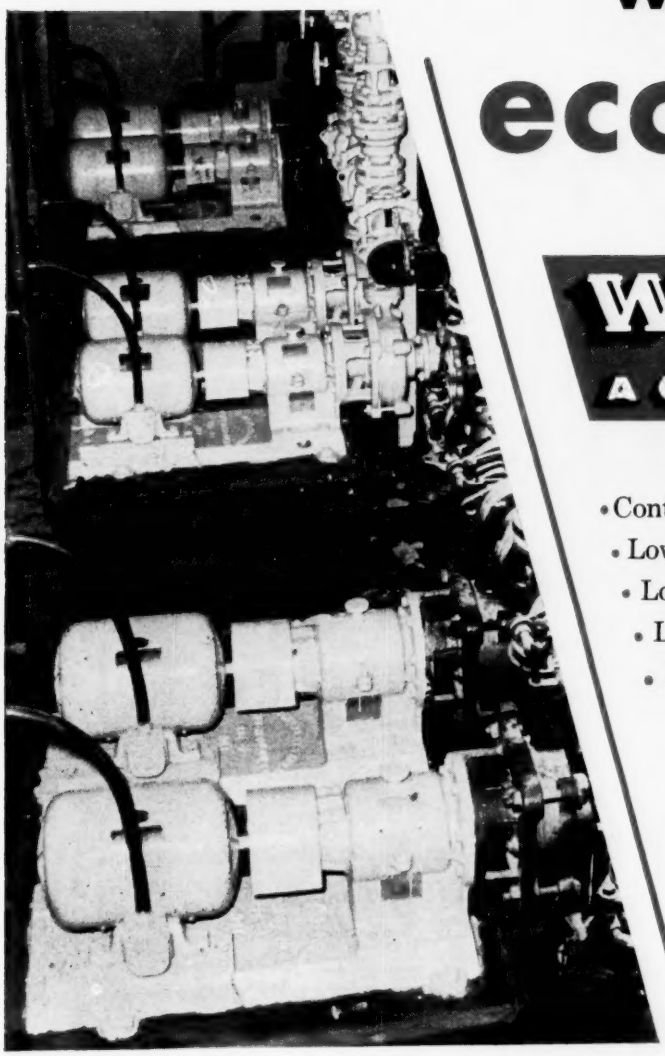

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®Nash® Clean Air Compressors are simple, with only one moving element. No valves, gears, pistons, sliding vanes, or other enemies of long life and constant performance complicate a Nash. No aftercoolers are needed. You will find it profitable to investigate these pumps, now.

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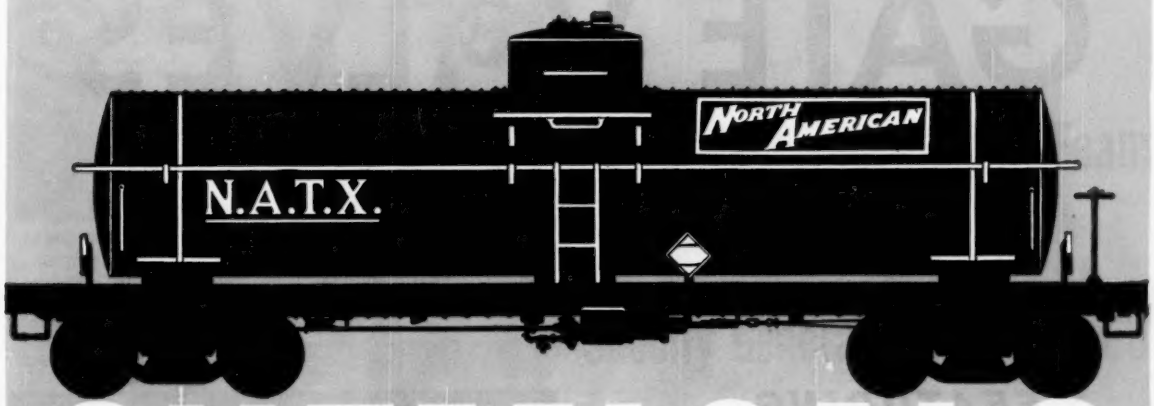

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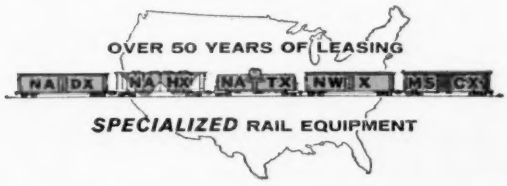
Lined especially to requirements, this modern North American chemical car helps you keep customers satisfied. It delivers your product at destination safe, sure, clean and pure as the day of shipment. Special cars lined by you eliminate contact with metal, corrosive action and contamination . . . they help you build repeat business through your superior service to customers. Specify North American—and get *satisfaction!*



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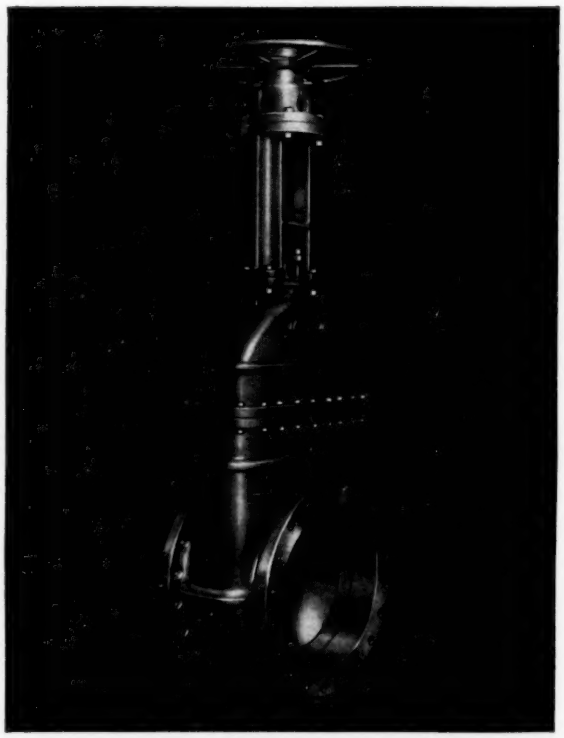
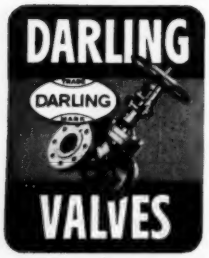
BY DARLING

FEATURING:

unmatched advantages of DARLING fully revolving double disc parallel seat gate valve principle!



There's new economy to be gained in the handling of "problem" fluids and gases with Darling aluminum alloy gate valves . . . now available in ½" through 24" sizes. We have data on initial and long-range costs and performance that will interest you. Write for facts.



DARLING VALVE & MANUFACTURING CO.
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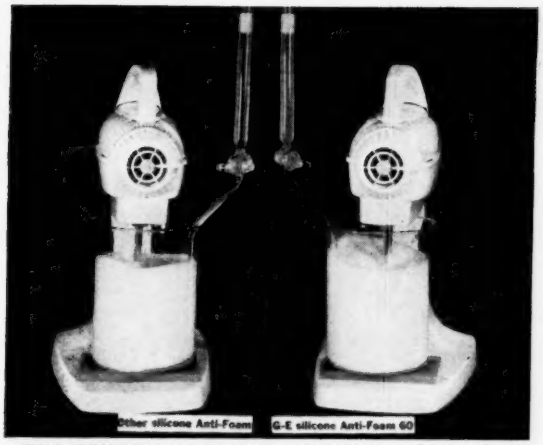
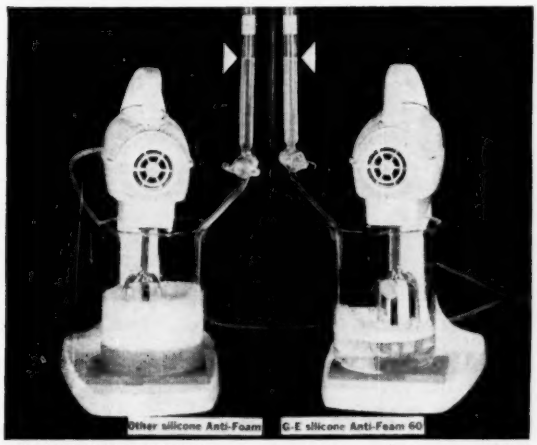
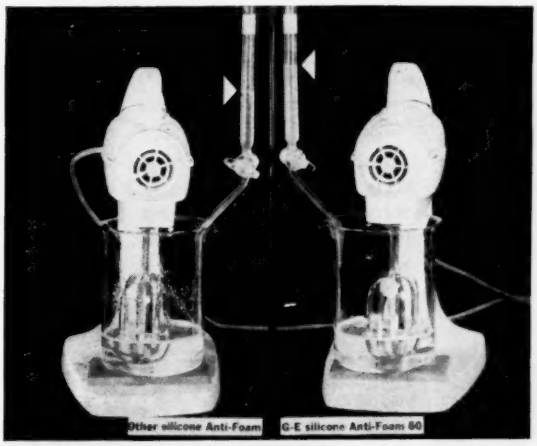


TWO IDENTICAL DETERGENT SOLUTIONS are beaten for 10 minutes at the same speed. Left burette contains dilute solution (0.1% silicone solids) of other leading silicone anti-foam. Right burette contains similar solution (0.1% silicone solids) of G-E Anti-Foam 60.



EQUAL QUANTITIES (3 cc) of anti-foam solution are added to each beaker, sufficient to kill initial foam in both beakers. When beating is resumed for 5 minutes, heavy foam again forms in beaker containing anti-foam "X" (left), but not in beaker with G-E AF-60.



FOAM IS COMPLETELY DESTROYED by adding anti-foam to each beaker until it is impossible to restore any foam by continued beating. This takes 5.8 cc of anti-foam "X", only 3.9 cc of G-E AF-60.

30% Less Silicone Anti-Foam Needed When You Specify General Electric AF-60

The test at left, of course, only proves the superior economy of General Electric AF-60 in one foaming system. But it is typical of the success being reported for AF-60 in many aqueous systems.

The best test for you is to try G-E AF-60 in your own operations. You'll find it disperses faster than any other silicone anti-foam, yet G-E AF-60 comes to you in a higher concentration to reduce inventory and storage costs. We'll be glad to send you a free sample if you mail the coupon below. General Electric silicone fluids and compounds are also available for efficient low-cost defoaming of non-aqueous solutions.

GENERAL ELECTRIC

SILICONE PRODUCTS DEPARTMENT,
WATERFORD, NEW YORK

MAIL THIS COUPON FOR A FREE SAMPLE . . .

Section A3E5, Silicone Products Department
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Please send me a sample of G-E Anti-Foam for

☐ aqueous system ☐ non-aqueous system

Application_____

Name_____ **Position**_____

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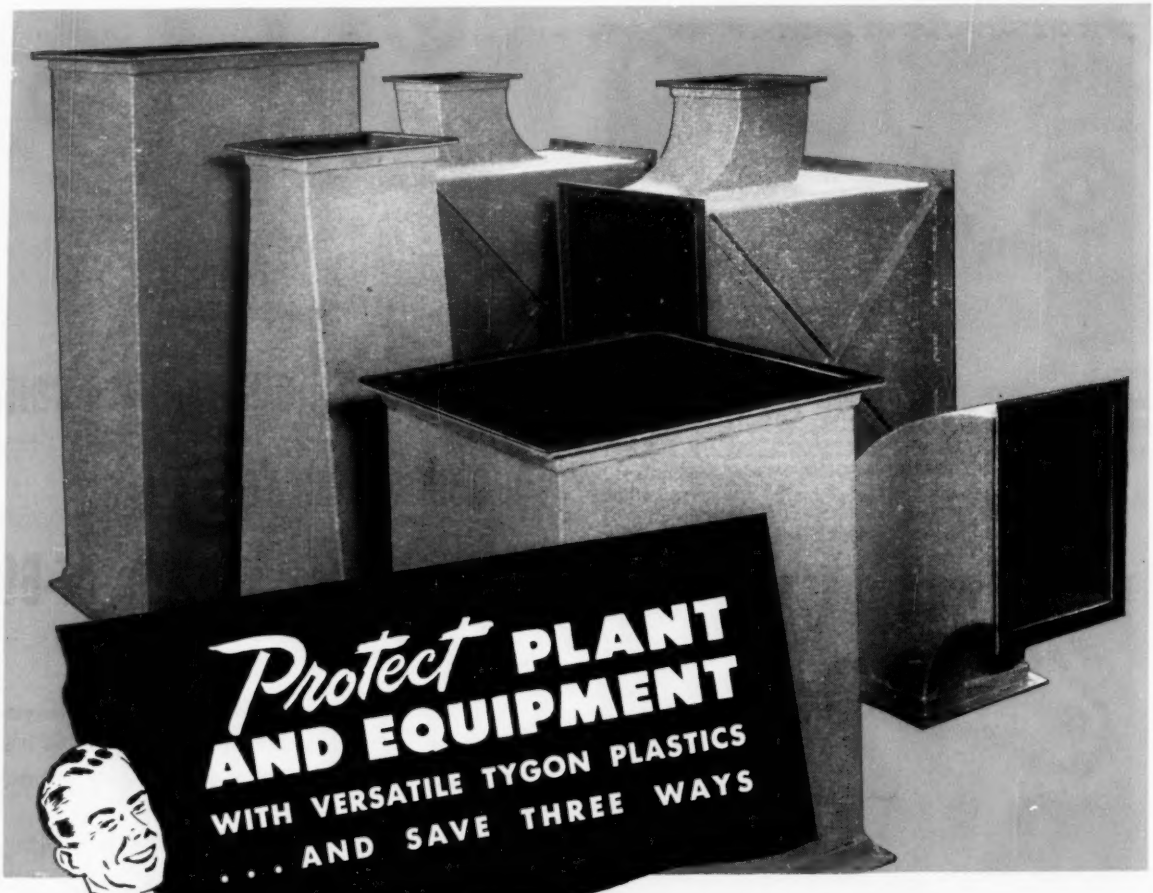

Protect PLANT AND EQUIPMENT

WITH VERSATILE TYGON PLASTICS . . . AND SAVE THREE WAYS

1 LOWER MAINTENANCE COSTS

2 LESS PLANT "DOWN-TIME"

3 LESS SOLUTION LOSS

When you use versatile Tygon Plastics to protect buidings, tanks, ducts, pipe, valves, pumps and other equipment from corrosive attack, you're not only sure of longer, maintenance-free life, but: 1. You reduce "Down-time" resulting from taking equipment out of production for repairs or replacement, and 2. You avoid product or solution loss from corrosive contamination.

Tygon Plastics are resistant to a wider range of chemicals than any other material of construction, with the exception of glass and chemical stoneware. Yet, Tygon Plastics have a versatility in use approached by no other material.

For example: Tygon sheet linings $\frac{3}{32}$" thick can be applied to tanks, ducts, pipe and valves from 2" dia. up. Tygon cut or molded gaskets provide pressure tight, corrosion-resistant seals; Tygon molded mechanical goods items can be made to virtually any shape and in a wide range of hardnesses; Tygon flexible Tubing, in bores up to 3", makes an excellent piping medium for gas, air or liquids.

Tygon Paint, a liquid form of these versatile plastics, provides unexcelled protection for tank exteriors, machinery, walls, and structural steel exposed to the attack of corrosive fumes or acid spillage.

In one or more of their many forms, Tygon Plastics offer the engineer quickly effective ways to keep maintenance costs in check—superior ways to prolong plant and equipment life. If you'd like full data on all the Tygon Plastics, write for the Tygon Portfolio.

181F

PLASTICS AND SYNTHETICS DIVISION . . .

U. S. STONEWARE

Since 1865 • Akron, Ohio

Chemical Engineering

Developments

MAY 5, 1958

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Competition for fluidized iron-ore reduction 52

The conventional rotary kiln has entered the iron-ore-reduction race with a fresh bid based on process economies and versatility (it handles a wide variety of ores).

Another nitric acid process makes its debut 56

Montecatini's ammonia-oxidation process, installed at U. S. Steel's new integrated nitrogen plant in Provo, Utah, incorporates some unique process features.

This vulcanizer is a mighty fast operator 60

It's part of a new continuous process—which breaks away from using conventional air-steam curing media—the liquid medium transfers heat six times as fast as air.

These two plastics are now easier to handle 64

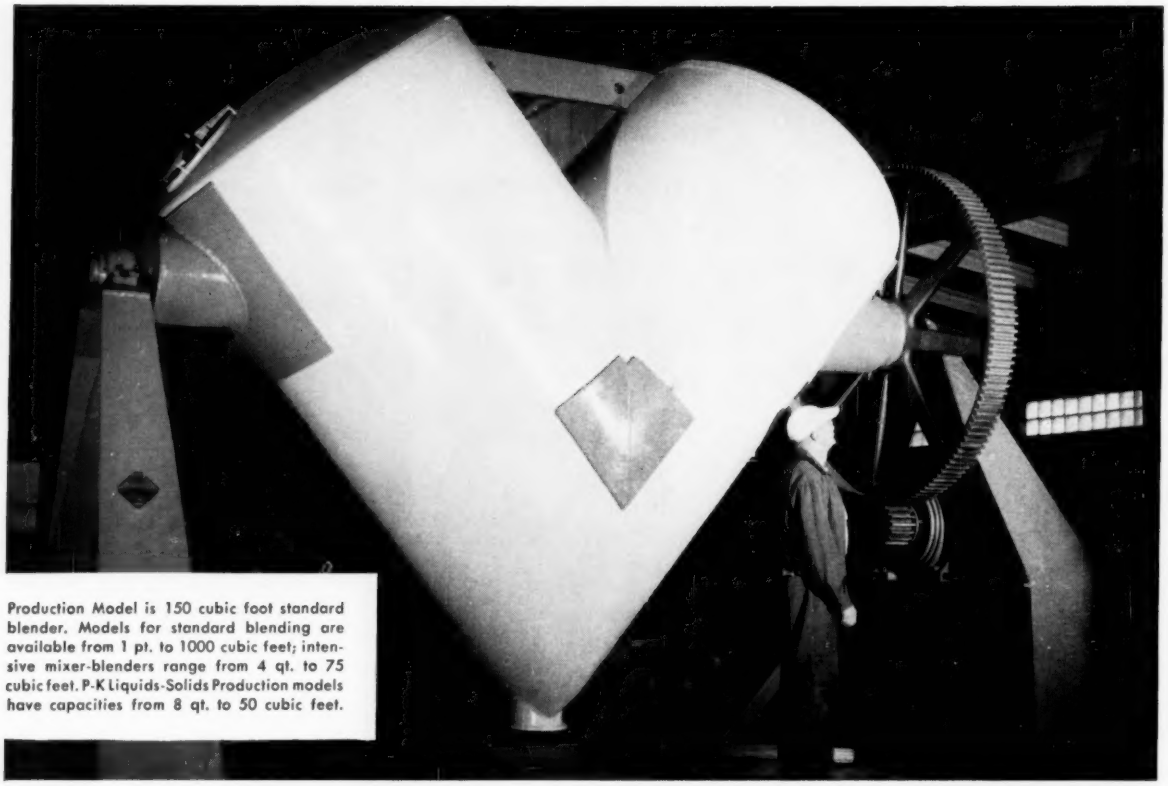
Because of low-melt viscosity, you can use conventional processing machinery to turn out new Teflon and polyethylene products—once made only on special equipment.

The latest in equipment developments 70

Pyrometer for low-temperature operations . . . Pressure filter has versatile leaf-assembly design . . . Manometer cabinet . . . Super-lift hoist has needle-threading precision . . .

From '58 on: More aromatics from petroleum 78

There's less coke-making what with steel's 40% slump. So, oilmen are happily filling industry's needs for benzene, toluene and xylene by tapping petroleum sources.



Production Model is 150 cubic foot standard blender. Models for standard blending are available from 1 pt. to 1000 cubic feet; intensive mixer-blenders range from 4 qt. to 75 cubic feet. P-K Liquids-Solids Production models have capacities from 8 qt. to 50 cubic feet.

Production Results Prove Superiority of P-K's New Blending Concept

Leading companies in virtually all the chemical and process industries have found that P-K "Twin-Shell" blenders have met their blending requirements better . . . faster . . . and more economically than conventional mixer-blenders.

P-K makes 3 types of "Twin-Shell" models to meet practically all blending functions – there is a production model for standard precision blending, a model for *intensive* mixing-blending, a model where exact quantities of liquids are introduced and intimately blended into dry solids.

These models are all based on P-K's radically different "Twin-Shell" blending concept which has a proven mechanical advantage that pays off in fast, consistently uniform blends . . . dust-free, moisture-proof operation . . . and quick, easy discharging.

The fundamental "Twin-Shell" mixing principle combines a gentle rolling, folding and dividing action within the entire mass of material to create a rapid and uniform blending of formulations regardless of varying particle size, shape or density. Furthermore, the smooth, interior of the "Twin-Shell" blender shape affords complete accessibility for fast, easy cleaning – quick changeover for new formulations without fear of contamination.

Prove these benefits yourself at P-K's Customer Service Lab

P-K can help you to determine accurately the right type of "Twin-Shell" blender for your needs. Complete lab facilities are available for blending materials from 4 qts. to 3 cubic feet (working capacities) – comparison tests can be made on the spot. You and your staff can conduct your own blending studies . . . or you can utilize P-K's qualified blender technicians to assist you in product research. This service is available without obligation because P-K recognizes that more and more companies realize the importance of pre-testing before purchase – they realize too, the need to keep their present blending methods up-to-date. If it is impossible for you to conduct these tests personally, arrangements can be made for you to send us your formulations for testing. In either case, contact Russell Dotter at P-K.

For technical data on P-K "Twin-Shell" blenders for production or laboratory use, write for bulletins 15a-1 (lab) or 15 (production). The Patterson-Kelley Co., Inc., 1505 Hanson Street, East Stroudsburg, Pa. Phone: Stroudsburg 820.

All P-K "Twin-Shell" blenders are patented and the name registered.

15

Patterson Kelley

Chemical and Process Division

P-K "Twin-Shell" Blenders • Heat Exchangers • Packaged Pilot Plants • P-K Lever-Lock Doors • P-K Vacuum Dryer Blenders

DEVELOPMENTS . . .

MAY 5, 1958

Chementator

C. H. CHILTON

Chemical storage of solar energy is being tried out by BASF in Germany. Acridine dyestuffs, exposed to the sun, use about 25% of the radiation to form new chemical compounds. In the dark, process is reversed, with release of previously absorbed energy.

Leaky zirconium container, core of Oak Ridge's homogeneous reactor, forced early termination of full-design-power (5,000 tkw.) test last month. Enriched uranyl sulfate was detected in heavy water blanket surrounding the core.

Despite today's slump in the titanium business, New Jersey Zinc is building a pilot plant with two commercial-size cells for fused-salt electrolysis. Company believes that a new low-cost process can pump life back into Ti metal.

New ion exchange technique catches on

Moving-bed ion exchange wins its first job in U. S. uranium industry with startup in March of Lucky Mc Uranium Corp.'s new 750-ton/day mill in the Gas Hills district of Wyoming. Similar units were put in at six Elliot Lake, Ont., mills during the past year.

According to consultant-designer Robert Porter, Lucky Mc's system costs 15% less than an equivalent-capacity fixed-bed system, offers valuable operating advantages as well.

Adsorption columns have unusually deep (6½ ft.) beds of relatively coarse (0.52 mm.) beads. With this combination, the 7-ft.-dia. columns handle 400 gpm. of clear pregnant liquor, 200-300% more than fixed-bed columns of the same diameter.

When resin becomes loaded, hydraulic displacement transfers bed to an elution column, where it is first backwashed to remove slimes. Resin is then eluted with solution of nitric acid and sodium nitrate. Final washing with sulfuric acid leach solution displaces costlier nitrate ions from the resin, keeping them in the elution circuit instead of losing them to the barren leach liquor.

Only the resin moves between adsorption and elution sections. All other flows stay within their related sections, thereby avoiding accidental mixing of pregnant liquor with backwash, eluate or acid wash.

Lucky Mc's adsorption system uses two sets of three series-connected columns; one additional set of three columns handles backwashing, elution and acid washing.

Take a fresh look at dialysis

Late developments in acid-resistant membranes for dialysis (selective liquid diffusion) may boost the commercial stature of this long-neglected unit operation.

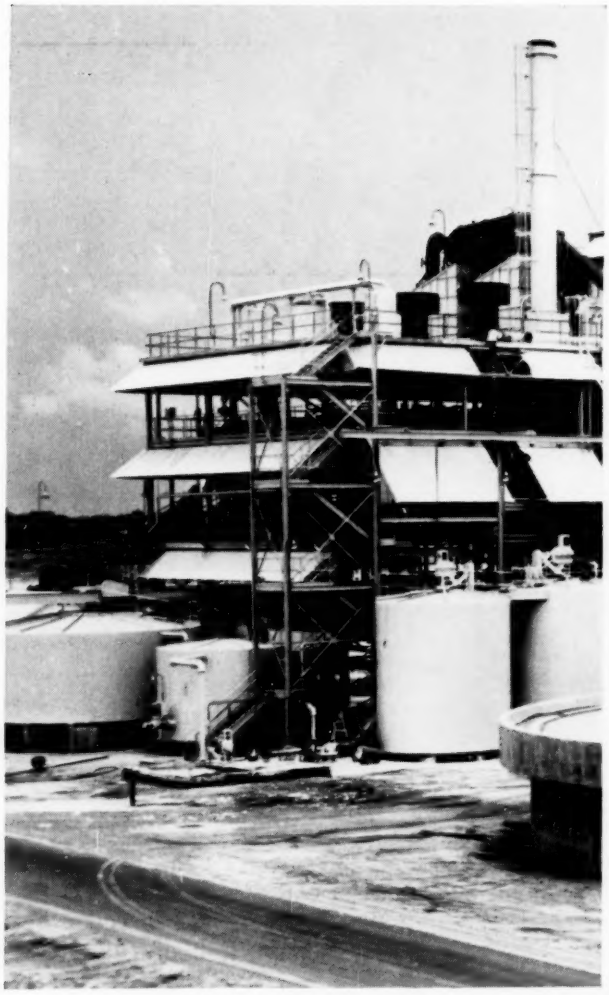
First fruit borne by this work is a 900-sq.ft. dialysis unit now being used by a leading copper producer to separate 750 tons/yr.

(Continued on page 48)

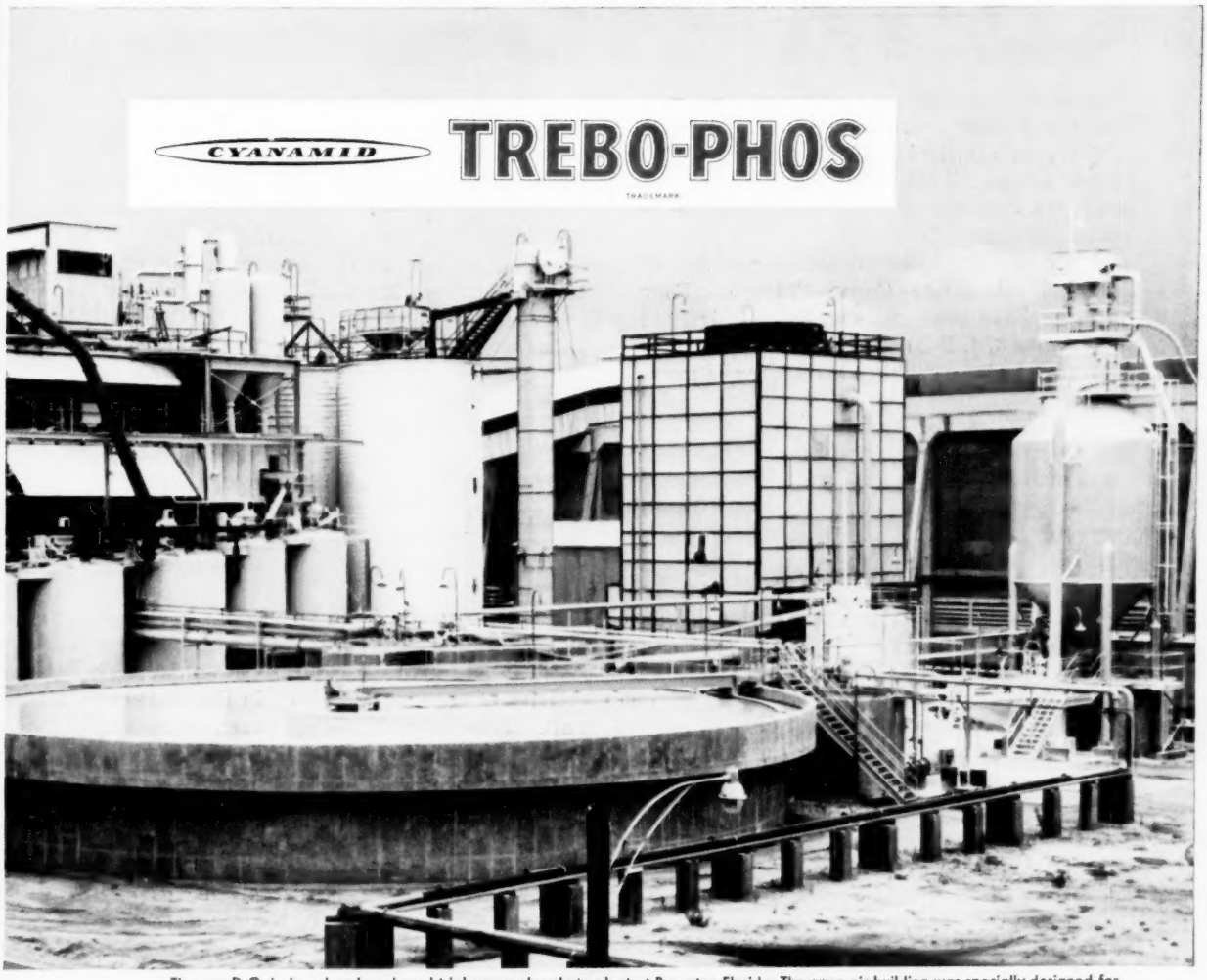
Dorr-Oliver Designs and Engineers

NEW 200,000 TON PER YEAR TRIPLE SUPER-PHOSPHATE PLANT

for American Cyanamid Company . . . at Brewster, Florida



The new Brewster, Florida plant of the American Cyanamid Company, one of the nation's largest chemical corporations, reached its design capacity of 200,000 tons per year of triple superphosphate in less than 3 months after initial start-up. Operating with the largest single stream phosphoric acid reaction system, made possible by a new type of vacuum cooling device, this plant produces a non-granular fertilizer which is ideal for subsequent ammoniation and compounding. The daily production of 600 tons consumes 220 TPD of high strength P_2O_5, and 600 TPD of H_2SO_4. Dorr-Oliver's 40 years of experience in the field of phosphoric acid and concentrated fertilizer production was fully



The new D-O designed and equipped triple superphosphate plant at Brewster, Florida. The open air building was specially designed for light, ventilation and economy. Note the water recovery and neutralization section in the foreground, the outdoor reaction system, and the two Doyle Scrubbers on top of the building.

utilized in the design of this plant.

Already established as one of the cleanest fertilizer plants ever designed, the Brewster mill far exceeds all requirements of the Florida Pollution Authority. Fumes and gases are scrubbed in series through two Doyle Scrubbers which each handle 25,000 CFM. Acid wastes are neutralized and clarified prior to discharge. An absolute minimum of water is consumed as 3,200 gpm is reclaimed in a 90′ dia. Dorr Clarifier. Make-up water in the water reclamation plant totals 800 gpm or only 20% of the total process water.

Another D-O development is the Dorr-Oliver Traveling Pan Filter installation, where three 18 square meter units with a filtration area of 195 square feet are installed. Two of these units handle 1,100 tons of gypsum per day.

If you are considering entering the fast growing fertilizer field — or if you plan to expand present plant facilities — it will pay you to check with Dorr-Oliver. Write for Bulletin No. 8000, or better still, let us send an engineer to discuss your problem from the standpoint of economics and process. No obligation, of course.

DORR-OLIVER
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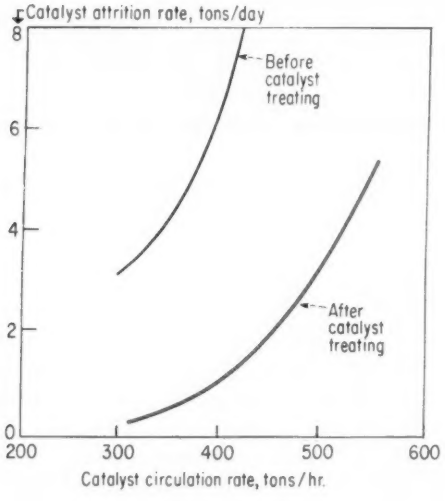
STAMFORD • CONNECTICUT • U.S.A.

of sulfuric acid from dissolved nickel sulfate. These materials are recovered from electrolytic-copper cell liquor after prior removal of copper sulfate. Alternative method would be costly vacuum evaporation to crystallize the nickel sulfate.

The new vinyl membranes are products of National Aluminate Corp., Chicago. Four varieties have been made to date, designated as Nalfilms 3, 4, D-20 and D-30. The company had already been making ion exchange membranes (Nalfilms 1 and 2) for electrodialysis of salt and brackish water.

Conventional dialytic membranes, such as parchment used in dialysis of caustic soda in the rayon industry, can't stand the punishment of sulfuric acid. With new membrane materials available, dialysis can be expected to take on a wide variety of separation jobs. Nalco aims to make membranes with controlled sizes and numbers of pores, hence with specific selectivities and diffusion rates.

Get more mileage from your catalysts



A new catalyst treating process will enable petroleum refiners operating moving-bed cracking units to slice their catalyst attrition losses drastically, says California Research Corp. (Standard Oil of Calif. subsidiary).

The new process, already in operation in eight units at six refineries, puts extruded clay or bead catalyst through a "complex chemical and physical process" that makes it more resistant to abrasion. Treatment is applied to the catalyst circulated during normal operation of a cracking unit.

Process details are unavailable at present. Presumably some chemical agent is involved; estimated treating costs include \$5/day per 100 tons of catalyst inventory for unidentified "materials." Capital cost is placed at less than \$5,000 for a 20,000-bbl./day cracker.

One air-lift Houdriflow unit, handling 13,000 bbl./day, has chalked up 18 months' experience with treated catalyst. Catalyst losses used to be 3.1 tons/day; they are now only 0.7 tons/day. Other indicated advantages of the new process:

- Cracking units limited by coke-burning rates can increase their capacity 5-10% by speeding rate of catalyst circulation.
- Fewer fines in the system improves contacting efficiency, reduces pressure drop, lightens cyclone load and decreases erosion of equipment.

Although the treating process does not affect catalyst activity per se, longer useful catalyst life gives a slightly lower average activity of catalyst inventory in the cracking unit. This effect can be offset, says Cal Research, by boosting circulation rate or by increasing bed temperature.

Fresh water via solvent extraction?

Temperature-dependent solvent extraction may be the sleeper in the sea-water desalting race. Researchers at Texas A. & M., working under government contract, report significant progress in search for an ideal solvent.

In the proposed process, sea water would be contacted with a solvent at low (ambient) temperature. A relatively large quantity of water would go into solution in the solvent, but little solvent would be dissolved in the brine. The solvent and brine phases would be separated, then the solvent phase heated moderately to break the bonds of hydration and free the water from solution. Solvent is cooled and recycled.

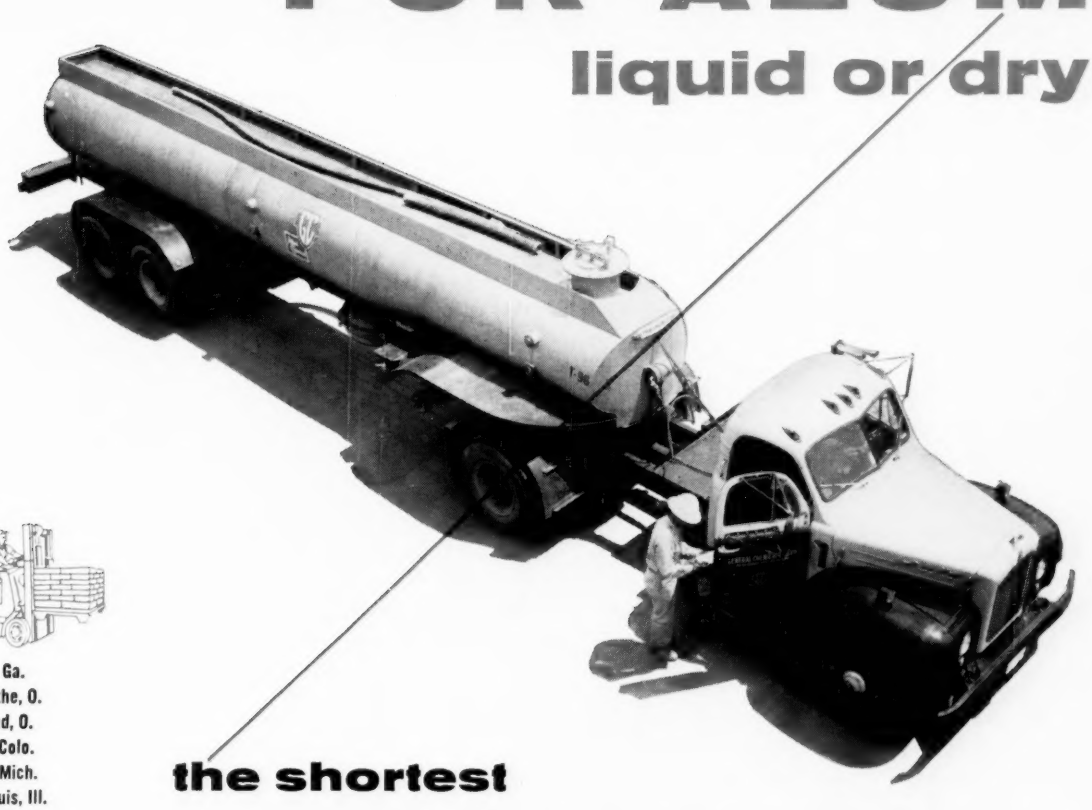
D. W. Hood and coworkers have studied more than 200 commercially available organic compounds, establishing in this way the types of molecular structure which offer the most promise. They have found that secondary amines have nearly ideal solvent properties but show other shortcomings.

Glycol and glycerol ether compounds look pretty good. One of them, 1-butoxy-3-ethoxy-

(Continued on page 50)

FOR ALUM

liquid or dry



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2-propanol, has good solvent characteristics except that throughout the temperature range it dissolves more water than is desirable. The A. & M. group is currently engaged in synthesizing a molecule of slightly different structure which, it is hoped, will give ideal solubility relations.

Expected advantages of this process over other desalination techniques:

- Low temperatures eliminate problems of high-temperature corrosion and scaling.
- Low-level or waste heat can be used.
- Corrosion is minimized because of the inhibiting nature of the solvents.

Vertical shaft kiln fights back

An engineering development under way in Australia is aimed at restoring to the vertical kiln some of its former stature in the cement industry.

This development, now being pilot-planted by Gippsland Industries Ltd., Melbourne, attempts to combine process advantages of the wet cement process with economies of the vertical kiln. Compared with conventional dry processing, the wet process is cleaner and permits closer control of cement composition. Compared with the usual wet-process rotary kiln, a vertical or shaft kiln is lower in investment and fuel consumption. Big drawback is that finely ground raw materials can't be handled in a shaft kiln without first putting them through an agglomeration step.

The approach being explored by the Aussies would be applicable to existing wet-process, rotary-kiln mills wishing to expand their output. Slurry feed, mixed with coal, would be pelletized and partially dried by putting it through a rotating drum heated with offgases from the existing rotary kiln. The pellets, containing about 15% water, would then be fed to a modern vertical kiln.

The Gippsland pilot plant includes a rotary dryer-pelletizer 2½ ft. diam. and 9½ ft. long. A company spokesman terms the results of work to date as "highly satisfactory."

New process: Alumina from coal wastes

The road to high-grade alumina from low-grade sources is marked with the bleaching bones of the many who have passed that way before. Latest to make the start: Strategic Materials Corp. and North American Coal Corp., who are jointly attempting to wring metallurgical alumina from coal-mine wastes.

Work is now under way in Strategic's pilot plant at Niagara Falls, N. Y., seeking the most attractive route for a proposed commercial venture at the coal company's Powhatan Mines on the Ohio River.

Strategic's process consists of leaching mines wastes (15-25% Al_2O_3) with high-strength sulfuric acid, followed by separation and decomposition of iron and aluminum sulfates to yield commercial alumina and iron oxide. Strategic claims three areas of novelty, subjects of patent applications:

- An acid digestion which recovers more than 90% of available alumina in one contact (reportedly at 400 F.).
- Separation of iron and aluminum at low cost to produce cell-grade alumina.
- Virtually 100% recovery of acid values (after allowing for that consumed by alkaline materials in the coal waste) without resorting to either a sulfate electrolysis or a contact acid plant.

If the process proves out (there's plenty of skepticism in the trade) there are mountains of dirt-cheap raw material awaiting—1,500 tons/day at North American's mine site—and several potential alumina buyers within barging distance on the Ohio.

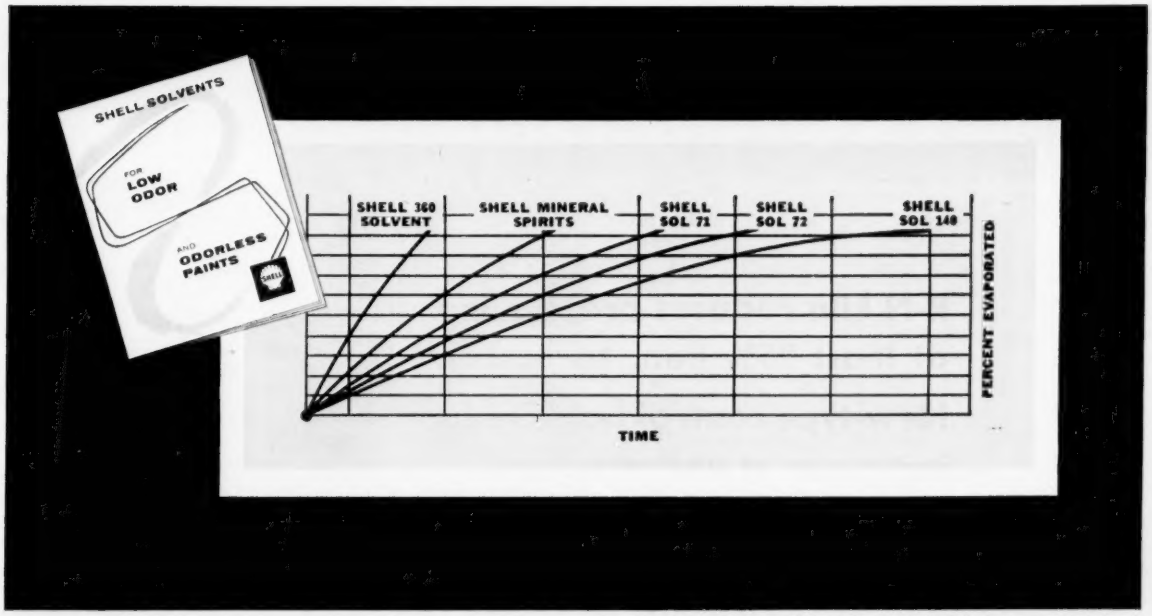
France seeks U-235 independence

Following rejection last December by Euratom nations of a French proposal for joint construction of a uranium-235 plant, France is reportedly planning to go ahead with its own gaseous diffusion facility.

The French are apparently anxious to capitalize on their hard-won know in gaseous diffusion, derived sans the benefit of U. S. and British information. Late last year the first cell of a diffusion pilot plant was put into operation at the Saclay atomic center near Paris; 12 such cells should be running by now.

Four different types of diffusion membrane materials have been studied. First was a ceramic (probably aluminum oxide), followed by Teflon and nickel. The fourth material, not yet identified, is said to be just as effective as ceramic membranes but a good deal cheaper. The ceramic material in the first study had a porosity of 60%, with hole diameters on the order of 0.01 micron and membrane thickness about 0.2 mm.

For more on DEVELOPMENTS.....52



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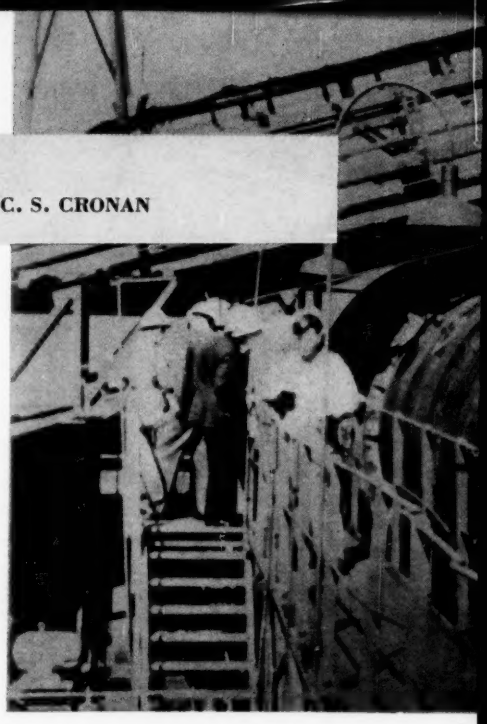


R-N kiln reduces ore, having at least 25% iron, to metal.

New-type control holds reducing gases at uniform heat.

Shell inlet ports feed air into kiln to burn gases as they flow through.

Rotary Kiln Enters Iron-Ore-Reduction Race

In the field of solids-gas contacting devices, the old-fashioned rotary kiln has stolen a march on the more glamorous, much-publicized fluidized-bed reactor.

While various steel companies and engineering groups have been vigorously conducting experimental programs to develop fluid-bed processes for direct reduction of iron ores (*Chem. Eng.*, Jan. 1957, pp. 130-134), Republic Steel and National Lead have been quietly grooming their rotary kiln process in a 175-ton/day pilot plant near Birmingham, Ala. Size of this experimental unit even dwarfs that of the first commercial fluid-bed direct-reduction unit now being engineered (Alan Wood Steel Co.'s 50-ton/day plant at Ivy Rock, Pa.).*

Although the pilot plant—with its 9 x 150-ft. kiln—has been operating for some three years, details of the R-N process were kept under wraps until the recent annual AIME meeting in New York. Process is available on license through R-N Corp., a joint subsidiary of Republic and National Lead. While several steel companies have shown genuine interest, none has yet reached a decision to go ahead with a commercial R-N plant under today's economic conditions.

*Proponents of fluid-bed processes, however, tout economic feasibility of small units as a major selling point.

▶ **Controlled Conditions**—In the R-N process, iron ore of any grade above 25% is reduced to a product of high metallic iron content in a controlled atmosphere and under controlled operating temperature. Temperature is below the melting point of iron, as well as below the melting point of the entire charge, using non-metallurgical solid-carbon reducing agents.

Precise control of operating conditions throughout the kiln is secret to success of R-N process. It is achieved by admitting adjustable quantities of air to the kiln through special ports spaced along the kiln length (*see photo above*).

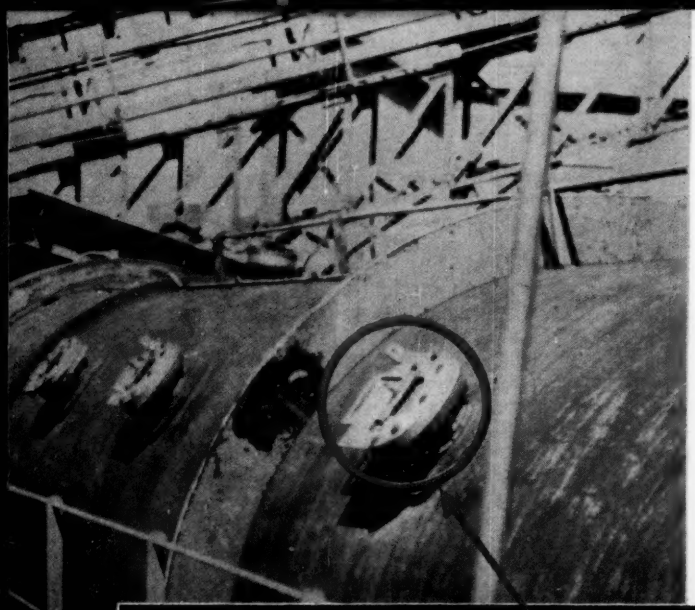
The pilot kiln is fired with natural gas. Under proper operating conditions, the combustion reaction products are largely carbon monoxide, hydrogen and nitrogen; carbon dioxide is at a minimum. The reducing character of these gases emerging from the combustion chamber provides available fuel for combustion heating farther along the kiln with the air induced through special ports. This technique results in a remarkably flat temperature profile of 1,950 F. over a major length of the kiln (*see table*).

▶ **Why Direct Reduction?**—R-N spokesmen cite a number of basic economic reasons for today's emphasis on development of processes which reduce iron ore without melting:

• Domestic reserves of high-grade, open-pit iron ore are rapidly being depleted. While magnetic-type low-grade ores can be readily beneficiated, available quantities of such ores are outnumbered some tenfold in the United States by nonmagnetic ores.

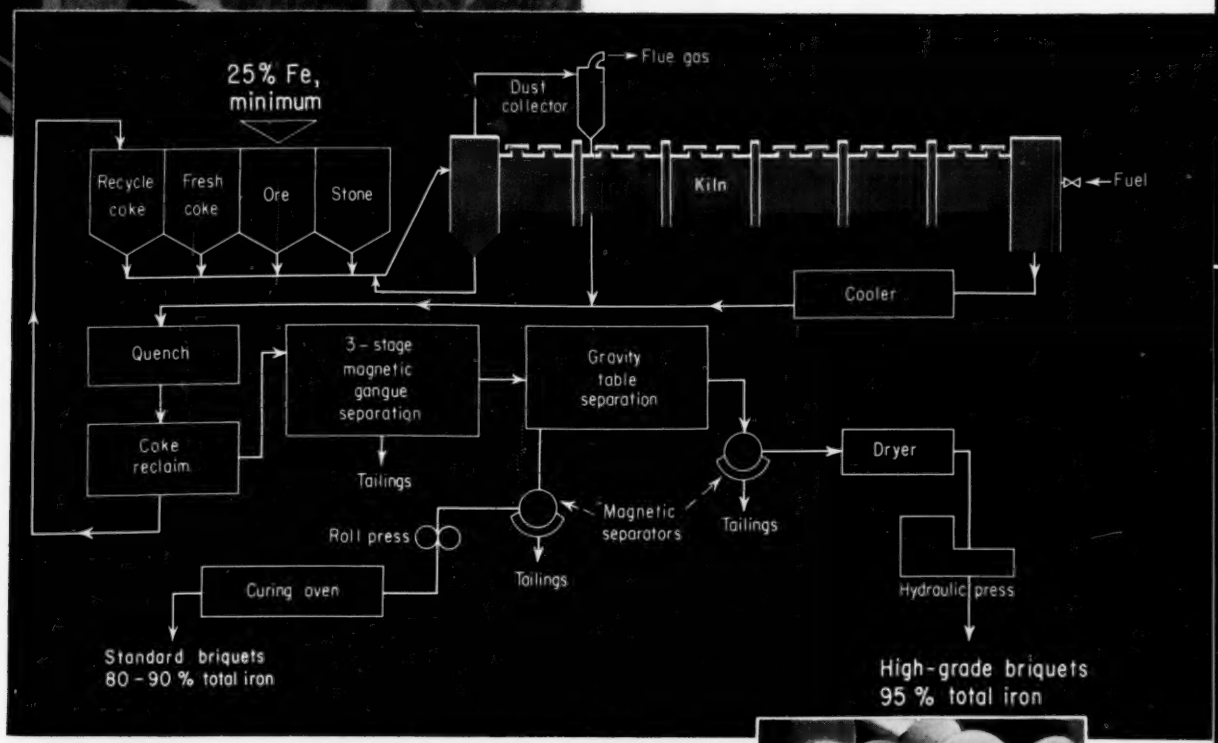
• Similarly, metallurgical coking coals are getting scarcer. We must upgrade iron ore to conserve coke; we must also find ways to replace coke with char made from noncoking coals.

• Today's high capital costs of coke ovens, blast furnaces and open-hearth furnaces provide a stimulating incentive to find alternative routes for making steel. Combination of direct reduction with electric melting appears to offer the lowest capital investment.



Rationed Air Flattens Temperature Profile

Distance From Discharge, Ft.	Gas Temperature, deg. F.	Bed Temperature, deg. F.
Combustion chamber	1,935	—
5	1,800	1,786
18	1,950	1,936
34	1,970	1,956
50	1,971	1,944
67	1,969	1,928
84	1,960	1,905
101	1,831	1,735
Feed end	670	—
Stack	512	—



• Supply, composition and prices of scrap iron and steel are subject to wide variations.

▶What R-N Can Do—Compared with most of the several-score existing or proposed direct reduction processes, the R-N process is more versatile in that it can handle a wide variety of ores.

With high-grade ores (50% or higher iron content), R-N can turn out a product containing 95% total iron, 90% or better metallic iron, with an over-all iron recovery of 85-90%. Such a product is suitable as feed for electric or open-hearth furnaces.

From low-grades ores (25-45% iron content), R-N can produce two grades of concentrate via magnetic and/or gravity separation of the kiln product. The high-grade concentrate is comparable to that obtained from high-grade ores. The standard product may contain 80-90% total iron, with 60-80% metallic iron; this fraction makes a particularly good blast-furnace feed.

Working with low-grade Alabama ores, the pilot plant has made concentrates in the ratio of about 70 parts high-grade product to 30 parts standard prod-

uct. Work now under way is aimed at bettering this performance by increasing this ratio and by improving the quality of the lower-iron-content fraction.

An important feature of the R-N process is that products are lower in titanium, manganese, chromium, phosphorus and sulfur than the initial ores. Rejection of these elements is in range of 55 to 95%.

▶ **How Process Works**—Crushed and sized ore (or balled fines) in the size range of up to 1 in. is fed to the rotary kiln, along with an excess of solid carbonaceous reducing agent (e.g., coke breeze, char, anthracite fines) and limestone or dolomite. Function of the latter is to pick up the sulfur content of the ore and coke.

Kiln may be fired with gas or oil. As ore travels through the kiln countercurrent to gas flow, it is dried, preheated and reduced. Reduction proceeds from the outside of the ore particle toward the center, changing magnetite (Fe_3O_4) to wustite (FeO) and finally to metallic iron. This produces a fresh metallic surface, which, devoid of iron oxides and smeared with dust, does not weld. Fluxing of the nonmetallic portions of the system is minimized because no significant amount of finely divided iron oxide is available to permit low-melting slags to form.

The desired temperature gradient and heat release pattern through the kiln—predetermined in the laboratory—are obtained by controlling the addition of air along the kiln. Average residence time in the kiln for low-grade Alabama ore is 3 to 5 hr.

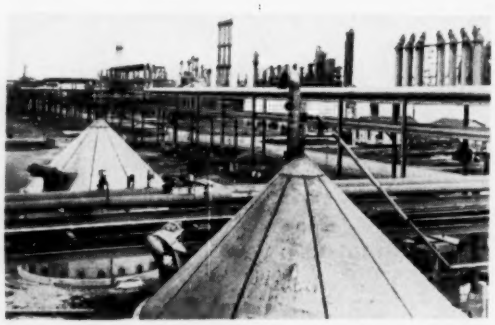
▶ **Finishing Steps** — Kiln discharge is cooled, then subjected to a series of separation steps (*see flowsheet*). The excess solid carbon fuel is cleaned, dewatered and recycled to the kiln. The magnetic products, containing the reduced or metallized iron, are freed of gangue by grinding, magnetic and gravity separation procedures.

Final operation is briquetting of the products. High-grade product is prepared for steel furnace feed by compacting to a density of 5-6 in a hydraulic press at 30 tons/sq. in. Briquettes are 4 in. diam. and 3 in. long (*see photo*). Low-grade product, for blast furnace or cupola use, is briquetted in peach-seed form to about 3.5 density.

▶ **Process Economics** — R-N engineers visualize a typical commercial plant as one producing 400,000 tons/yr. of concentrate from low-grade ore. Employing four 12½-ft.-diam. by 350-ft.-long kilns, such a plant would require an estimated $19 million in capital investment. Cost of product, of course, would depend on specific local conditions.

Large-scale tests in a Republic blast furnace using R-N briquettes (71% iron) showed coke savings of nearly 0.5 tons per ton of briquettes used. An important economic bonus is the lower phosphorus content of the pig iron produced—a critical factor with high-phosphorus Southern ores.

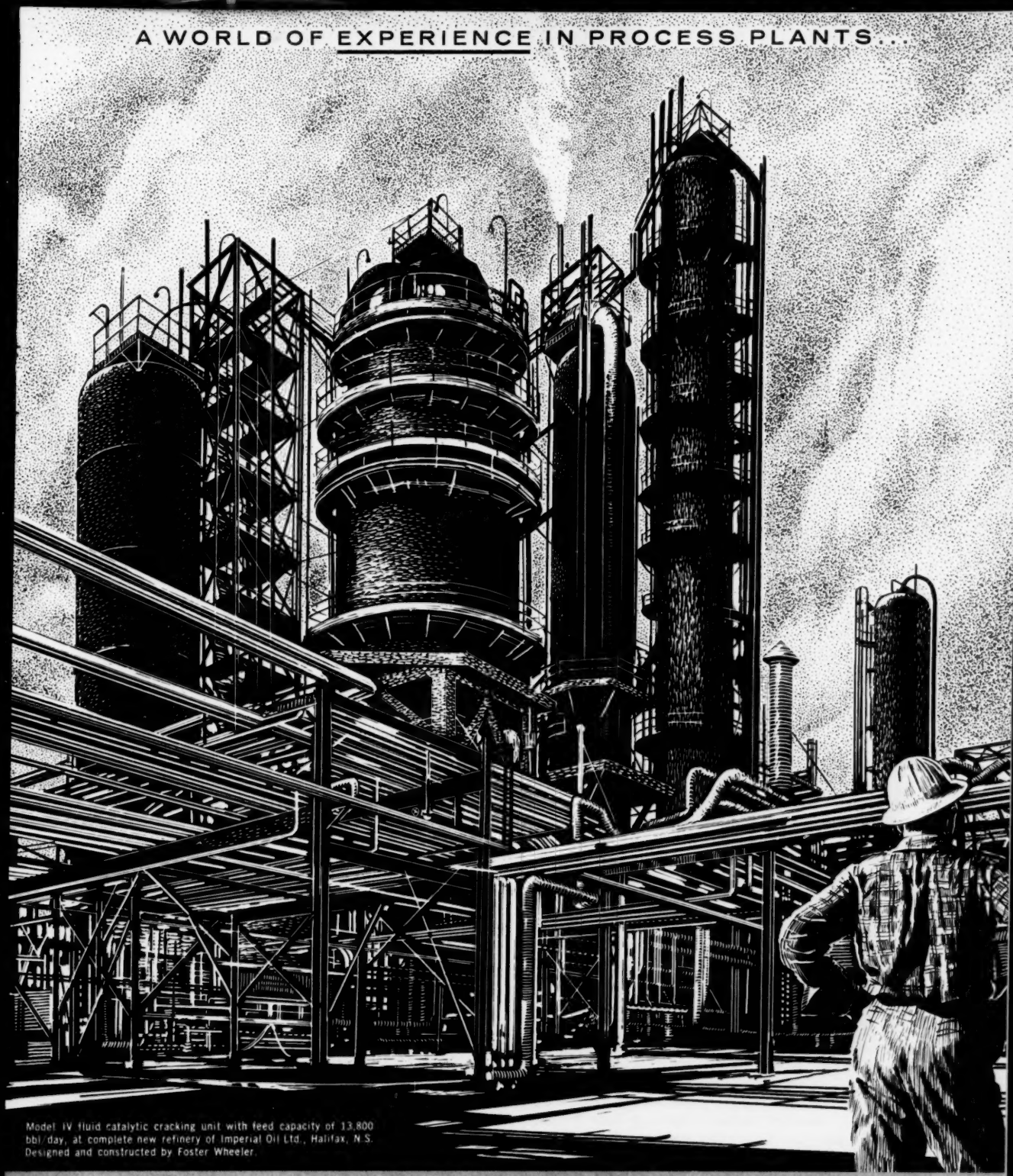
Similarly, Republic has successfully used high-grade briquettes (96% iron) in electric melting tests. On a strictly commodity basis, high-grade R-N concentrate is a competitor of scrap. However, where a new installation is being considered, R-N engineers believe, integration of an R-N plant with electric furnaces would in many cases be more attractive cost-wise than a blast furnace-open hearth combination.



Bakelite Tries Two-Flank Attack on Low-Pressure Poly Market

Geographically and process-wise, Bakelite Co. is making a two-flanked foray into the linear poly market. Bakelite has now swung on stream two completely automatic high-density polyethylene plants, one at Seadrift, Tex. (left), the other, at Institute, W. Va. (central control panel shown at right). Seadrift plant is based on Philips Process, while Institute plant uses Ziegler process. Seadrift plant produces 55 million lb./yr. of polyethylene, and Institute plant turns out 30 million lb./yr. Both plants, claims Bakelite, have technical improvements developed in Union Carbide laboratories. Key feature to ensure products' uniformity is new blending unit to make blends in box-car quantities.

A WORLD OF EXPERIENCE IN PROCESS PLANTS...



Model IV fluid catalytic cracking unit with feed capacity of 13,800 bbl/day, at complete new refinery of Imperial Oil Ltd., Halifax, N.S. Designed and constructed by Foster Wheeler.

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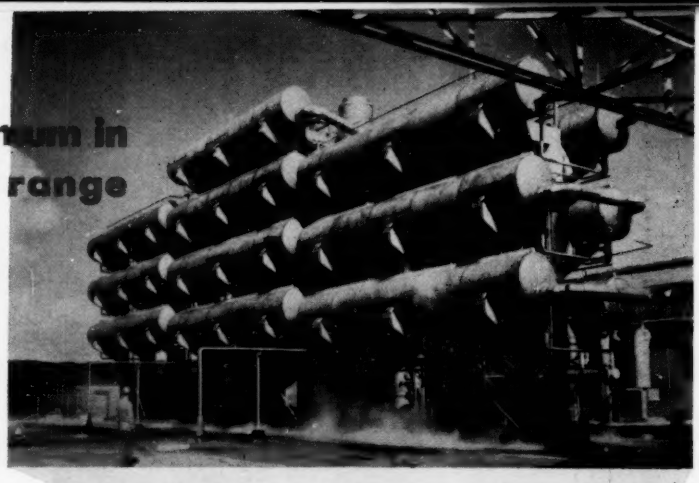
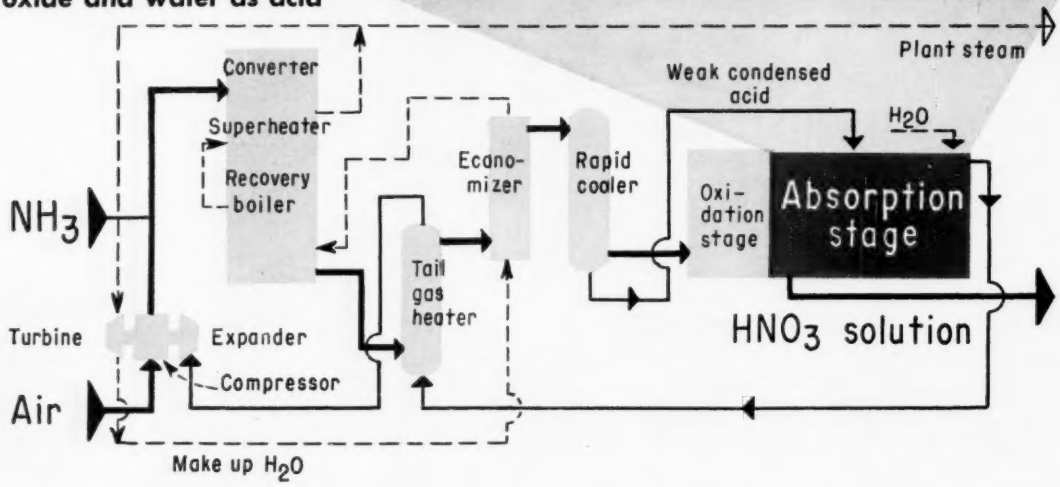
Sum of costs hits minimum in 40 psi. and 1,500 F. range

- **Reactor, heat recovery unit and steam superheater share common housing**
- **At 1,500 F., catalyst loss drops to low value**
- **Cascade absorbers combine oxide and water as acid**





Nitric Plant Optimizes at Medium Pressure

In making nitric acid, as in most everything else, there is no single "right way." The newest nitric acid process to make its U. S. debut is the Montecatini ammonia-oxidation process, installed in U. S. Steel's new integrated nitrogen plant at its Geneva Works, Provo, Utah.

Montecatini's process features an intermediate operating pressure—around 40 psi.—and ability to run at zero power input by shunting hot tail gases through a recovery turbine. By contrast, most pressure processes in this country, based on the basic Du Pont development in the twenties, operate in the 120 psi. range. Also featured in the Montecatini flowsheet (which is well established in Europe) are lower reaction temperature and some unique equipment design, centering around the novel absorbers shown above.

Built by Blaw-Knox Co., the USS plant has a total capacity of 200 tons/day ammonia, ammonium nitrate and nitric acid. The nitric acid section, which swung on stream last year, is rated at 160 tons/day on a 100% basis. This first U. S. installation will give engineers a chance to see how process stacks up against more familiar U. S. versions (see *Chem. Eng.*, May 1956, p. 171; Jan. 1956, p. 274; Nov. 1953, p. 150).

▶ **Low Pressure Saves Ammonia** —Explaining why it prefers the lower operating pressure, Montecatini goes back to basic process economics. According to the Italian chemical maker, cost of making nitric acid by any of the major processes breaks down as:

Ammonia	70-75%
Power, depreciation	15-25%
Platinum, labor, maintenance	5- 8%

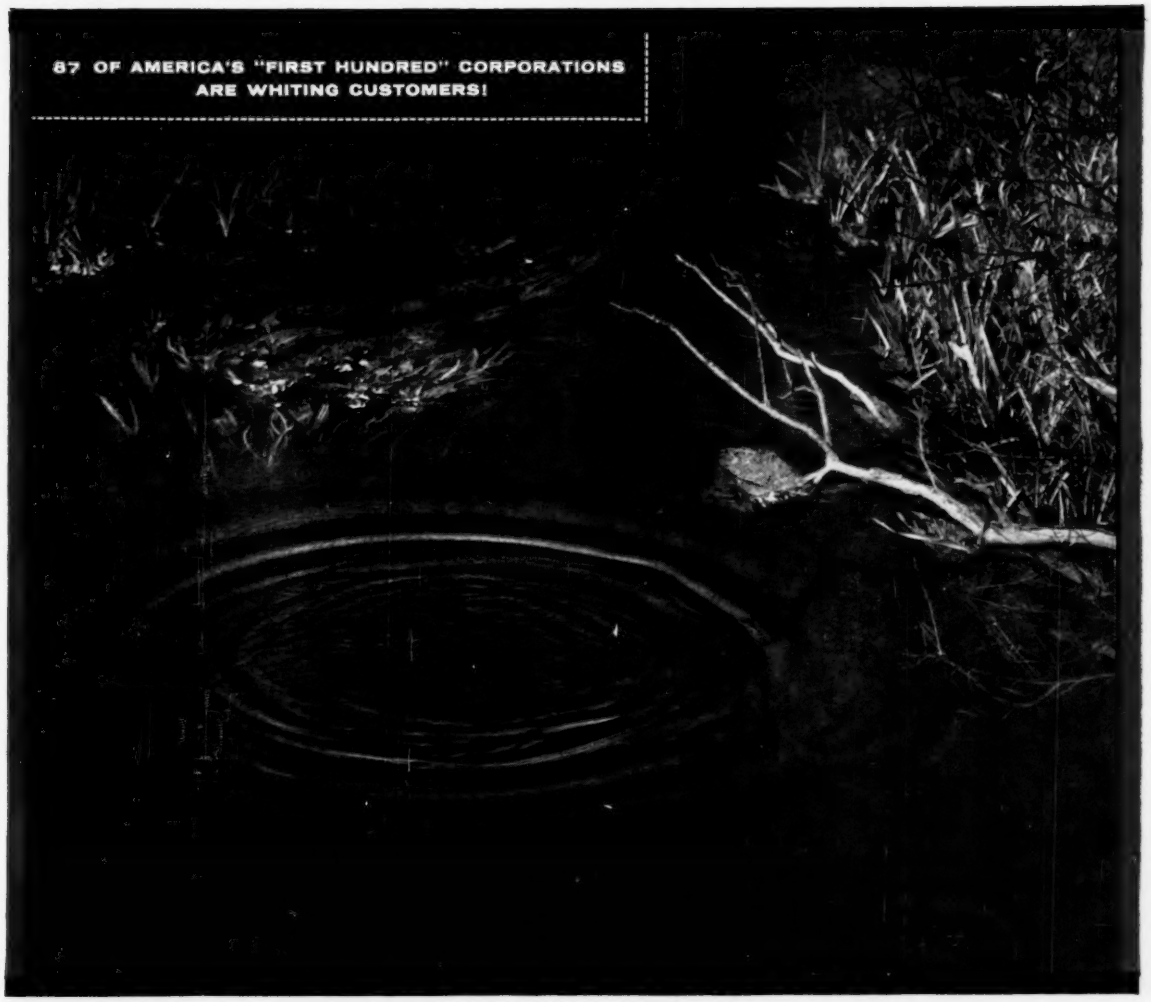
Because ammonia is the major cost item, conversion efficiency controls process economics (unoxidized ammonia does not recycle).

Combustion yield drops as pressure rises; therefore, process should operate at a low pressure for maximum oxidation efficiency. Montecatini estimates that its combustion efficiency (97-98%) would be lowered by at least 1% by upping pressure to the 100 psi. range.

On the other hand, when pressure rises more power can be recovered and depreciation charges shrink because plant is smaller.

The sum of all costs goes through a minimum which Montecatini calculates occurs around 40 psi. (plants range from 36 to 43 psi.). Over-all yields are 94-95% in Montecatini plants.

▶ **Saves Platinum, Too** — Identical optimizing procedures were



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applied to selecting an operating temperature. In Montecatini's process, temperature on the platinum catalyst is 1,470-1,540 F. compared to around 1,720 F. for the Du Pont process.

As reaction temperature rises, catalyst consumption goes up markedly. Montecatini studies showed that platinum vapor pressures at 1,430 F., 1,560 F. and 1,650 F. increase in a ratio of 1 to 44 to 560. And as temperature rises, catalyst gauze's mechanical strength declines, increasing the amount of powder entrained in reacting gases.

Ammonia conversion, however, drops as temperature drops. Efficiency at 1,560 F. is 98.5% sagging to 95% at 1,350 F. By selecting a temperature in the 1,500 F. range, Montecatini claims it hits the minimum point on the cost-temperature curve. At this temperature, platinum loss is 0.08 g./metric ton, about one-half the figure published for high-pressure processes. Catalyst loss is low enough so that usual platinum filters can be omitted.

An added bonus: Shutdowns for catalyst repair are at least three to four months apart. Many high-pressure plants must shut down every week or so.

▶ **Heart of Flowsheet**—Montecatini terms its reactor "the most characteristic part of the plant." Embodied within the reactor shell are the heat-recovery boiler and a steam superheater, next to the catalyst gauzes. (USS elected to use generated steam for process needs and drive compressors with an electric motor. So, there is no need for a superheater in its reactor.)

This design, claims Montecatini, costs less initially and accounts for higher heat recovery —5-6 lb. of steam for every pound of ammonia oxidized. Recovery boiler can be made of ordinary carbon steel.

Because of lower operating temperature, there is no need for air preheaters. And since the two exchangers following the reactor operate at fairly low temperatures (460 F. and 230 F.), corrosion problems are lessened accordingly.

▶ **Absorption Stage** — Cascade absorbers in the USS plant give the American engineer a glimpse at a seldom-seen bit of European absorption technology. The 20 horizontal stainless-steel absorbers (see photo), 6 ft. in dia. and 41 ft. long, replace tray absorbers commonly used.

In operation, these absorbers double as heat exchangers. Gaseous NO_2 enters a longitudinal channel submerged below the liquid level and bubbles at high velocity through perforated top of channel. NO, formed by the absorption reaction,

$$3\ NO_2 + H_2O \longrightarrow 2\ HNO_3 + NO$$

is reoxidized by air in the vapor space above the liquid and feeds to next absorber. Design of absorption system is controlled by reaction taking place in vapor space.

Heat of absorption is dissipated by spraying acid against inner walls of the vessel. A film of water, cascading down the outer shell wall, carries away the heat.

In plants ranging up to 160 tons/day of 100% acid, this design has the advantage of eliminating inside cooling coils. For larger units, Montecatini reverts to conventional tray absorbers with inside cooling coils.

▶ **Condense Before Oxidizing**—The NO coming from the reactor must be oxidized with air to NO_2 before absorption. In a typical high-pressure plant, NO is oxidized in a single cooler-condenser and then absorbed in weak acid.

In Montecatini's flowsheet, water vapor in reaction gases condenses out in a shell-and-tube rapid cooler ahead of the absorbers. Weakly acidic condensate passes to the top of the absorption system where it starts to enrich by contacting lean gas.

Elimination of water from the reaction gases permits full utilization of the absorption driving force of the gas. Acid at the bottom of the absorbers undergoing final enrichment contacts this NO_2 which is completely free of any diluting water vapor.

Giant Waste CO Boiler Saves Heat, Cuts Fumes

Slated to swing into operation this summer, a huge $1.25-million waste CO boiler at Ohio Standard's Toledo, Ohio, refinery will win substantial fuel savings and cut any serious pollution that might result from discharging "waste" gases to the atmosphere. (See *Chem. Eng.*, April 1954, pp. 114-118.)

High-temperature gases will come from a fluid cat cracker, key unit in Standard's new multimillion-dollar refinery. Being built by Babcock & Wilcox, boiler will recover 200 million Btu./hr. and will supply 450,000 lb./hr. of steam—enough for the entire refinery.

Fuel savings, B&W spokesmen estimate, will enable the boiler to pay for itself in about three years or less.

Convention Calendar

Cost-Reduction Conference, Illinois Institute of Technology, Chicago, Ill., May 8-9.

Stope-Fill Symposium, with sessions on Slurry-Pumping Problems, Montana School of Mines Campus, Butte, Mont., May 9-10.

American Petroleum Institute, Division of Refining, midyear meeting, Statler Hotel, Los Angeles, Calif., May 12-15.

Electrochemical Society, with sessions on Electrothermics, Metallurgy and Industrial Electrolytics, Statler Hotel, Washington, D. C., May 12-16.

Technical Assn. of the Pulp and Paper Industry, 9th Coating Conference, Bedford Springs Hotel, Bedford, Pa., May 14-16.

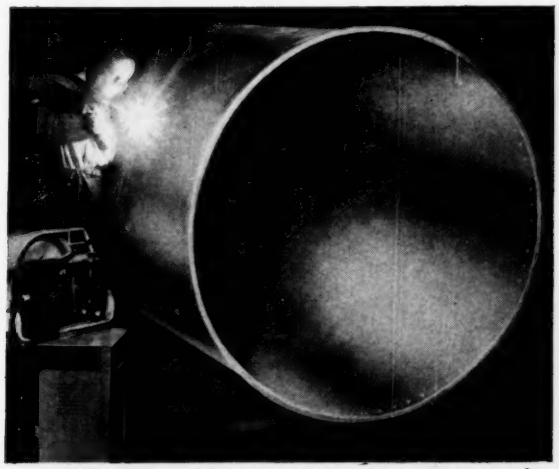
Air Pollution Control Assn., 51st annual meeting, Sheraton Hotel, Philadelphia, Pa., May 25-29.

American Chemical Society, Southwest Louisiana Section, jointly with Lake Charles Chemical Engineers' Club, one-day technical session, McNeese State College, Lake Charles, La., May 29.

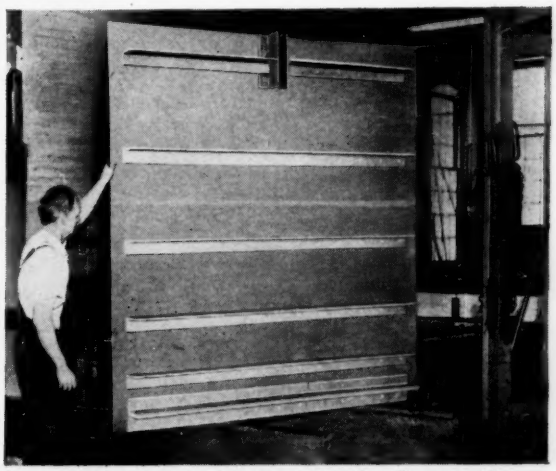
1958 European Congress of Chemical Engineering, with ACHEMA 12th Chemical Engineering Exhibition and Congress, Frankfurt am Main, West Germany, May 31-June 8.

CUT CORROSION LOSSES

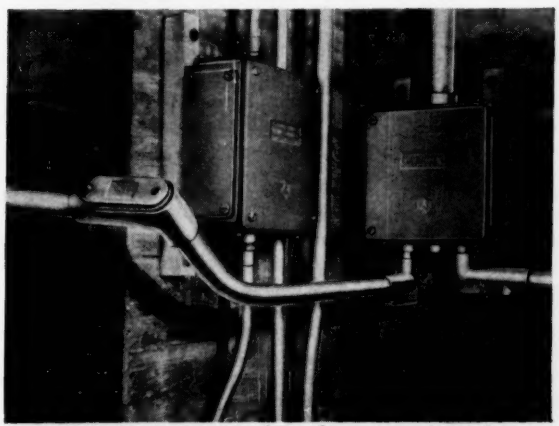
Get unusual corrosion resistance, plus high strength, toughness, weldability, and easy fabrication with Everdur,® Anaconda copper-silicon alloys



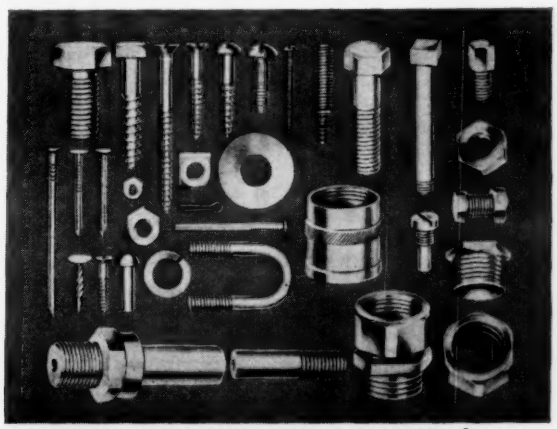
TANKS AND INDUSTRIAL EQUIPMENT requiring a combination of high strength, toughness and resistance to corrosion. Hot water storage heaters and tanks, unfired pressure vessels of Everdur are readily fabricated by welding.



IN WATER AND WASTE SYSTEMS, Everdur alloys provide easy fabrication and long service in a wide variety of jobs—from gates on to bolts and nuts. Their high strength makes possible lightweight, built-up assemblies of wrought metal.



ELECTRICAL CONDUIT of Everdur protects electric lines in corrosive environments, withstands vibration and abrasion —at oil refineries, in underwater tunnels (above), chemical plants. Made in two wall thicknesses—R.C. and E.M.T.



FASTENINGS AND SCREW MACHINE PARTS. Everdur is available in forms for hot heading and forging of bolts and accessories, severe cold-working operations for bolts and screws—and as free-cutting rod for screw machine products.

Whenever you have a tough problem calling for high strength with immunity to rust, and corrosion resistance equivalent to pure copper, consider an Everdur alloy. It may save you a lot of trouble and money. For details on properties and applications of Everdur alloys, write for Publication E-5. Address: The American Brass Company, Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ont. 6846

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Hot Liquid Bath Trims Curing Time to Seconds

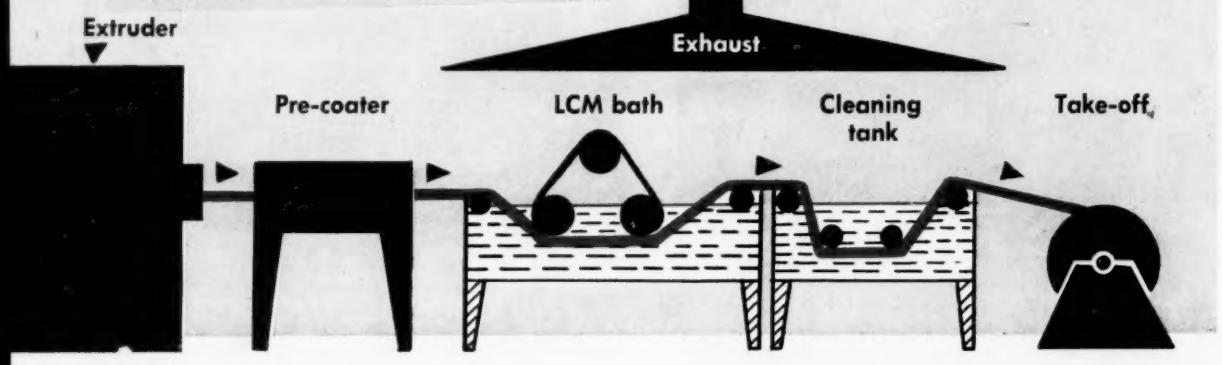
Either molten metal, organic or silicone liquid at 400 to 600 F. can heat extrusion six times faster than air does.

Developed for neoprene, method works on most rubbers, foam or solid, in any type of extrusion.

Figures Show Dramatic Speed of Liquid

	Conventional Vulcanizer	Liquid Vulcanizer
Curing time, min.	30	0.25-0.50
Curing temp., deg. F.	300	400-600 F.

Note: Rubber-coated wire now cured continuously with steam and air requires 200-ft. chamber; new process can do job with hot liquid in 20-ft. tank.



Continuous Vulcanizer Cures Extrusions Fast

CONTINUOUS curing of elastomeric extrusions is riding forward on its first strong push toward industry-wide commercial use. A new continuous process, using a liquid curing medium, fully vulcanizes most cross-sections in 15 to 30 sec. compared to 30-min. exposures required by batch processes. A departure from conventional air-steam curing media the liquid medium transfers heat about six times as fast as air.

▶**Long-Sought Answer** — Long an industry goal, continuous curing to date has been commercially realized only for special cases like rubber-coated wire. The new LCM (liquid curing medium) method — developed by Du Pont for neoprene—works on almost all types of rubber, including GR-S, on foam or solid in any type of extrusion.

Extruded uncured compound feeds directly through a bath of molten metal or a hot organic or silicone liquid. Temperatures of 400 to 600 F., compared to batch processes' 300 F., cure rubber within seconds.

▶**Savings Lure Users**—Du Pont reports that an experimental unit in its Wilmington elastomers laboratory has attracted visitors from every major sponge and rubber manufacturer and that just about every one plans some use for it. A number of companies are already operating.

One manufacturer reports that total manufacturing costs run 25% less than conventional curing methods. In general, savings result from:

Speed—Commercial producers now operate as high as 60 ft./min. of cured material; speeds up to 100 ft./min. are foreseen.

Lower labor requirement—Between the extruder and finishing operation, no labor is required.

Less scrap — Finished cured extrusions can be coiled or cut to length immediately with no scrap losses from cut-off ends.

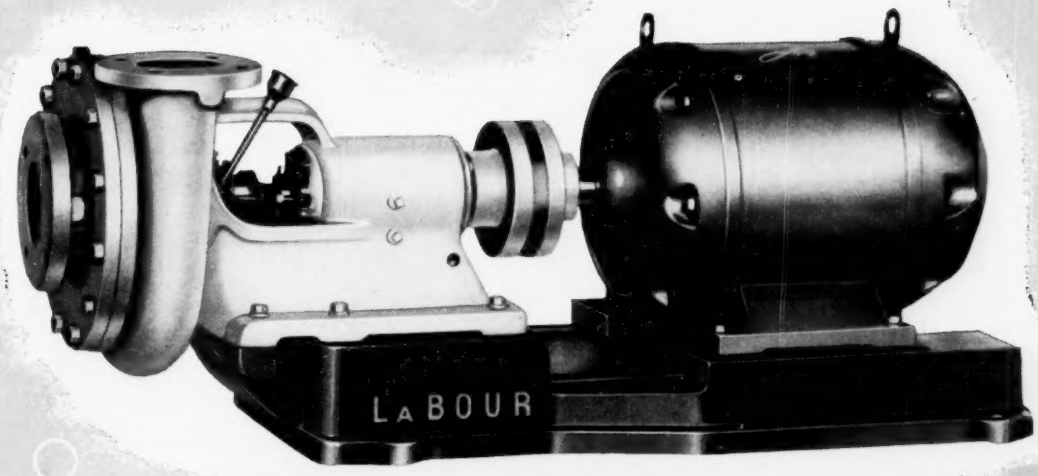
Lower investment, less space—Manufacturers of extruded wire coatings now use continuous steam vulcanizers as long as 200 ft.

Typical commercial user of the new LCM method, D. S. Brown Co. of North Baltimore, Ohio, uses an 8-ft. tank (and is experimenting with a 16-ft. tank) to cure up to 40 ft./min.

The Brown company now continuously vulcanizes dense and cellular neoprene extrusions over a wide range of shapes and sizes. Temperatures range between 435 and 485 F.

▶**Putting on the Heat**—Curing

when BUBBLES



mean TROUBLES

Aerated solutions and volatile liquids are difficult or impossible to handle with ordinary centrifugal pumps, yet in many operations use of positive displacement pumps just brings on troubles of a different kind. The answer is LaBour Type Q, a non-priming centrifugal with extraordinary ability to handle large amounts of air or vapor mixed with the liquid it pumps.

Occasional "gulps" of air or vapor will not bind a LaBour Type Q. In general, Type Q can rid itself of gases not exceeding 20% of the total volume being pumped. Thus it is suited for many applications which would otherwise require a more costly self-priming unit.

LaBour dependability is of course a feature of this pump, which has only one moving part and no close clearances. If you're having an air or vapor problem, particularly in connection with corrosive liquids, you'd better drop us a line.

ORIGINAL MANUFACTURERS OF THE SELF PRIMING CENTRIFUGAL PUMP

LABOUR

THE LaBOUR COMPANY, INC. • ELKHART, INDIANA, U. S. A.

time relates directly to the curing temperature. Other factors: speed of passage through the tank, shape or cross section and over-all size or volume of the part being made.

Extrusions can be vulcanized on a practical basis at bath temperatures of 400 to 600 F. compared to 300 F. for batch processes. Molten metals are generally the preferred curing liquids because they can be used at the high end of the temperature range, allowing the fastest cures. Best so far seems to be a bismuth-tin alloy, Asarcolo 281.

To extrusions such as thin-walled hollow tubing, however, high density of the metal causes distortion. A low-density type of heat transfer medium—inexpensive high-flash mineral oils for oil-resistant rubbers, heat-stable silicone oils for wider use—is used in these cases.

▶ **Powder Helps**—Following the extruder, some type of pre-coating device may be needed, depending on the type of heat transfer medium used. Putting uncured extrusion through a talc box keeps metal from wetting the rubber surface during curing.

Basic part of the equipment is the curing tank. Its length is determined by the operating temperature, the cure rate of the compound and the extrusion rate.

Insulated with at least two inches of rock wool or similar material, it can be heated electrically by either immersion-type heaters or by strip heaters applied to the outside of the tank. Extrusion is conveyed through bath with a series of driven rollers or by a thin stainless-steel belt.

Following the curing tank, a cleaning or cooling tank is required. Extrusion then moves directly to a wind-up reel or can be cut to length for shipping.

▶ **Pore Antidote**—Probably porous extrusions were the biggest roadblock Du Pont researchers overcame to make their process practical. Caused by expansion of gases or volatile materials as the extrusion heats and cures, porosity is prevented by simply avoiding the use of volatile plasticizers. To deal with porosity caused by entrapped air normally found in rubber compounds, they use a vacuum extruder.

Pouring (above) and pulling copper cakes (below) in Asarco's new continuous casting process.

Continuous Casting In Quick-Chill Mold

No longer are copper cakes cast individually at American Smelting & Refining's Perth Amboy, N. J., refinery. Its new semi-continuous casting process now turns out copper cakes 25 ft. long, up to 36 in. wide and weighing up to 17,000 lb. at a rate of 160 tons/8-hr. shift.

Long cakes can then be cut into lengths specified by copper rolling mills; with longer cakes available, mills will be able to boost sheet and strip output.

Molten copper for casting operation comes from Asarco's new arc furnace (*Chem. Eng.*, Mar. 10, 1958, p. 78). Metal is poured into a 15-in.-deep, water-cooled bottomless graphite mold at floor level. Copper is chilled so rapidly that it emerges from bottom of mold as a smooth, dense cake.

An hydraulic ram in the water-filled pit beneath mold lowers cast cake at about 20 in./min. (note water spray marks on cake being withdrawn). Three cakes can be cast at one time.

Nitric Bids for Role In Uranium Leaching

Currently jacking up the cost of solvent extracting uranium from the raw ore is the slurry filtration required after initial leaching; present commercial solvent extraction techniques can't be applied to ore slurries.

At New South Wales Univ. of Technology in Sydney, Australia, developers are drawing up plans for a pilot installation that can bypass this expensive slurry filtration. Proved on laboratory scale, process features leaching finely ground ore with nitric acid instead of sulfuric, then contacting slurry with 10% tributylphosphate-kerosene solution. Stripping extractant with water gives uranyl nitrate. Aussies won't say how they licked problem of solvent entrainment on slurry particles.

Developers at Vitro Uranium Co. are also working on a method to apply solvent extraction to leach slurries. While no breakthrough is in sight, results are said to be encouraging.

And evidently the Russians are pushing work on uranium-nitric acid technology. In the Russian magazine Atomnaja Energija, researchers describe an improved method for extracting uranyl nitrate with tributyl phosphate. Trick is feeding contacting streams through 0.3 mm. nozzles at top and bottom of extraction column, limiting size of droplets formed. Efficiency is 99.3% at three theoretical plates.

News Briefs

Sulfuric acid: Olin Mathieson Corp. has now started up a new 500-ton/day sulfuric acid plant at Beaumont, Tex., which boosts capacity at the site 250%, is constructing new facilities to make ammonium sulfate.

Vinyl chloride: Allied Chemical & Dye's Solvay Process Div. has now doubled vinyl chloride monomer capacity at its Moundsville, W. Va. plant. Ethyl Corp. is now making vinyl chloride monomer at its new plant at Baton Rouge, La.

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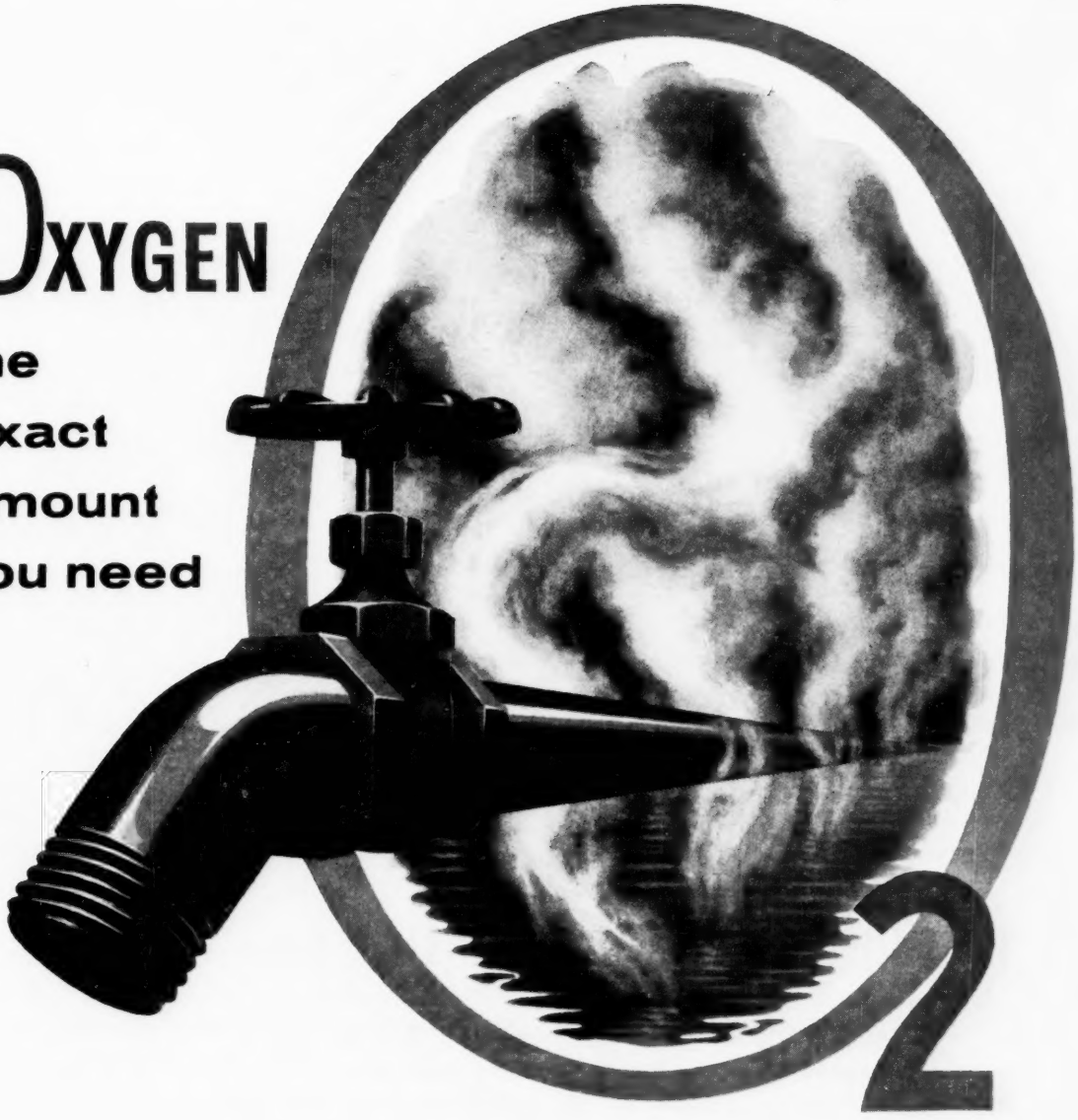

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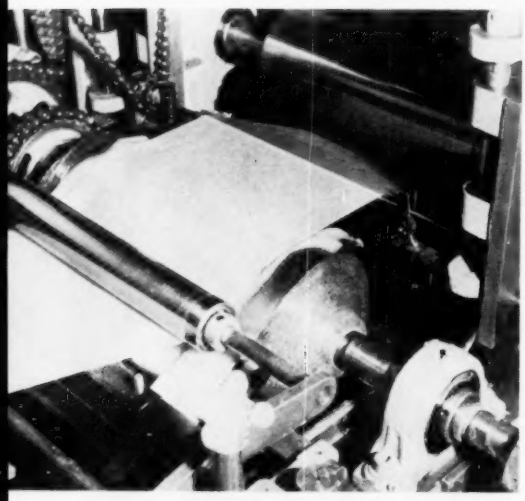
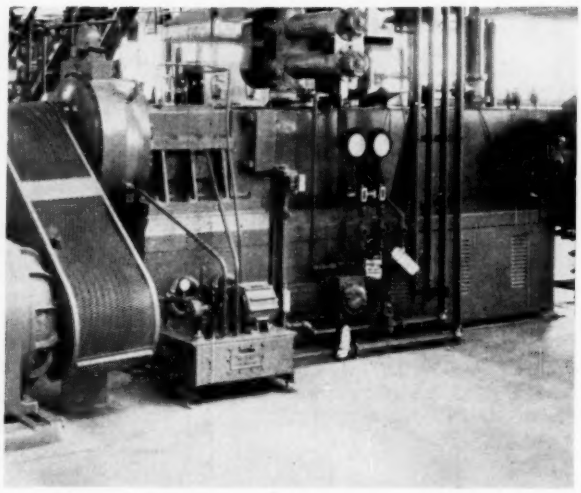
Standard Equipment, Special Plastics



New low-melt polyethylene
Lower melting point allows first direct application to paper using conventional coating equipment.



More extrudable Teflon
Experimental Teflon, which adds extrudability to properties of older cousins, now has go-ahead for commercial production.

Two Plastics Gain Ease-of-Use, New Markets

In addition to usual family assets, new Teflon and polyethylene products have low melt viscosities which make them processable on standard equipment.

Until recently, fabricators who wanted to take advantage of the outstanding physical, electrical and thermal properties of Teflon resins were obliged to use powder metallurgy techniques instead of extruding or molding on conventional plastics processing equipment.

Again, if paper coaters and converters wanted the chemical inertness, grease and water resistance and unusual strength of polyethylene-coated papers, they had to turn to special extrusion-laminating equipment instead of conventional wax coating machines.

Introduction of product variations with low melt viscosities not possessed by family forebears has put Teflon and polyethylene within reach of standard processing equipment.

Du Pont's Teflon 100-X, available for some time in development quantities, softens at about 545 F. and readily extrudes at 650 to 740 F. Company has just announced that commercial production will begin at a new Parkersburg, W. Va., unit by mid-1959. Manufacture of film from the new resin is also planned.

Both the old and the new Teflon resins are saturated fluorocarbons. Both are affected by a recent move to avoid confusion between the properties of different fluorocarbons. The Society of the Plastics Industry adopted two new common names. Teflon 100-X will be called FEP-fluorocarbon resin (FEP is for fluorinated ethylene propylene). The older Teflon tetrafluoroethylene resins will be called TFE-fluorocarbon resins.

Up to 400 F. both polymers share the same physical, electrical and thermal properties. The TFE-fluorocarbon resins can be used continuously at higher temperatures and have a greater flex life than the extrudable FEP-fluorocarbon resin.

The new resin is expected to accelerate development of applications previously not attempted with fluorocarbon plastics because of processing difficulties. Initially, they'll be used in jackets for coaxial and multiconductor cable, aircraft and industrial wiring, flexible and rigid printed circuits, electronic components,

Many users select caustic potash, rather than lower cost caustic soda, because it saponifies fats and grease more readily, and—most important—provides extra efficiency.

Since it is more reactive, the products made from it are also generally more reactive—more soluble, more effective. In fact, many powerful cleaners—including some of the popular heavy-duty liquid detergents—are based on products produced from caustic potash.

We invite you to make your own test of SOLVAY Caustic Potash. Available in two grades—Technical and Mercury Cell—dry forms and liquid, in steel drums and tank cars.

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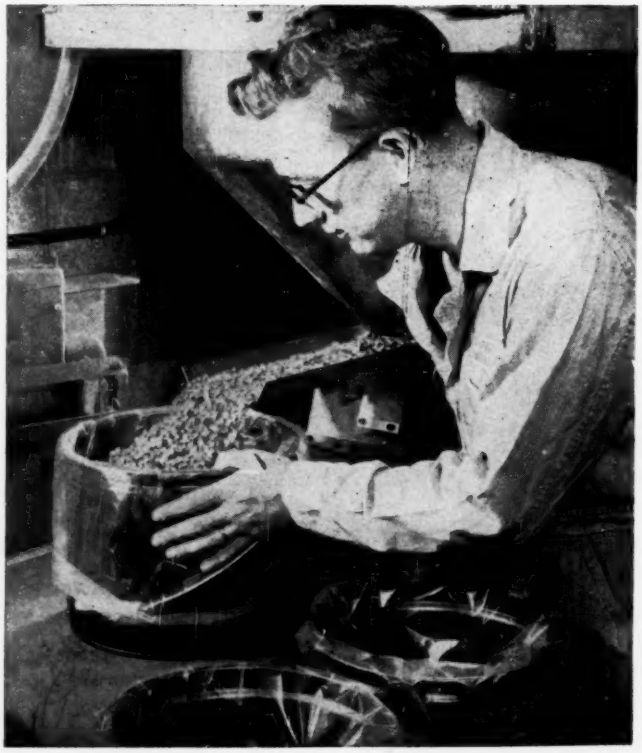

Reactive Zr Travels Safely in Polyethylene

In compliance with ICC rules, zirconium sponge is shipped to atomic reactors in a metal pail and protected from contact with the container by a sealed polyethylene liner.

Carborundum Metal Co.'s Akron, N. Y., plant uses liners developed by Cello-Pak Corp., Buffalo, N. Y. Argon gas is blown into the special package as an additional barrier against oxidation of the zirconium.—Bakelite Co., New York, N. Y. 66A

Graphite-Silicone Paint

Promises maintenance aid to chemical, steel, gas industries.

Field tests on a new all-weather industrial paint made of graphite and silicone show it withstands violent thermal shock in the 1,000 F. range.

Called Thermocone, it is said to be the first graphite silicone coating ever developed. It is expected to have particularly useful maintenance application in the steel, chemical and natural gas industries.

In tests, metal discs painted with Thermocone have been heated to temperatures of 1,000 F. and immediately plunged into beakers of icy water. Paint has shown no cracking, peeling, flaking or bubbling. Discs treated with other types of competitive weather paints disclosed damage to the paint immediately. **—Joseph Dixon Crucible Co., 167 Wayne St., Jersey City, N. J. 66B**

Colored Stainless

Parts can be severely formed after coloring.

Colored stainless steel is now available for architectural, decorative and other utilitarian uses as a result of a new coloring process developed for commercial use.

Called the Permyron process, it involves applying the proper pigment in a suitable vehicle to specially prepared surfaces by

tubing and packaging for corrosive products. — **Du Pont Co., Wilmington, Del. 64A**

The new low-melt polyethylene, called Epolene C, possesses many of the properties generally associated with plastic grade resins and yet can be handled much like a moderate to high melting point wax. At 300 F., for instance, the viscosity of the new resin is 8,000 cps. (*Chem. Eng.*, Feb. 10, 1958, p. 90). Addition of 25% paraffin reduces viscosity to only 1,300 cps.—**Eastman Chemical Products, Inc., New York, N. Y. 64B**

Newsworthy Chemicals

	Page Number is also Reader Service Code Number
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Low-melt polyethylene for coating paper	64B
Reactive Zr travels safely in polyethylene	66A
Graphite-silicone paint withstands severe thermal shock	66B
Colored stainless via new low-cost process	66C
Chemical tranquilizers take on the plant world	68A
Glass-reinforced foam has better strength, more give	68B
Amino triazole approved for use on corn	68C
Rigid polyethylene suits intermediate-sized molds	68D

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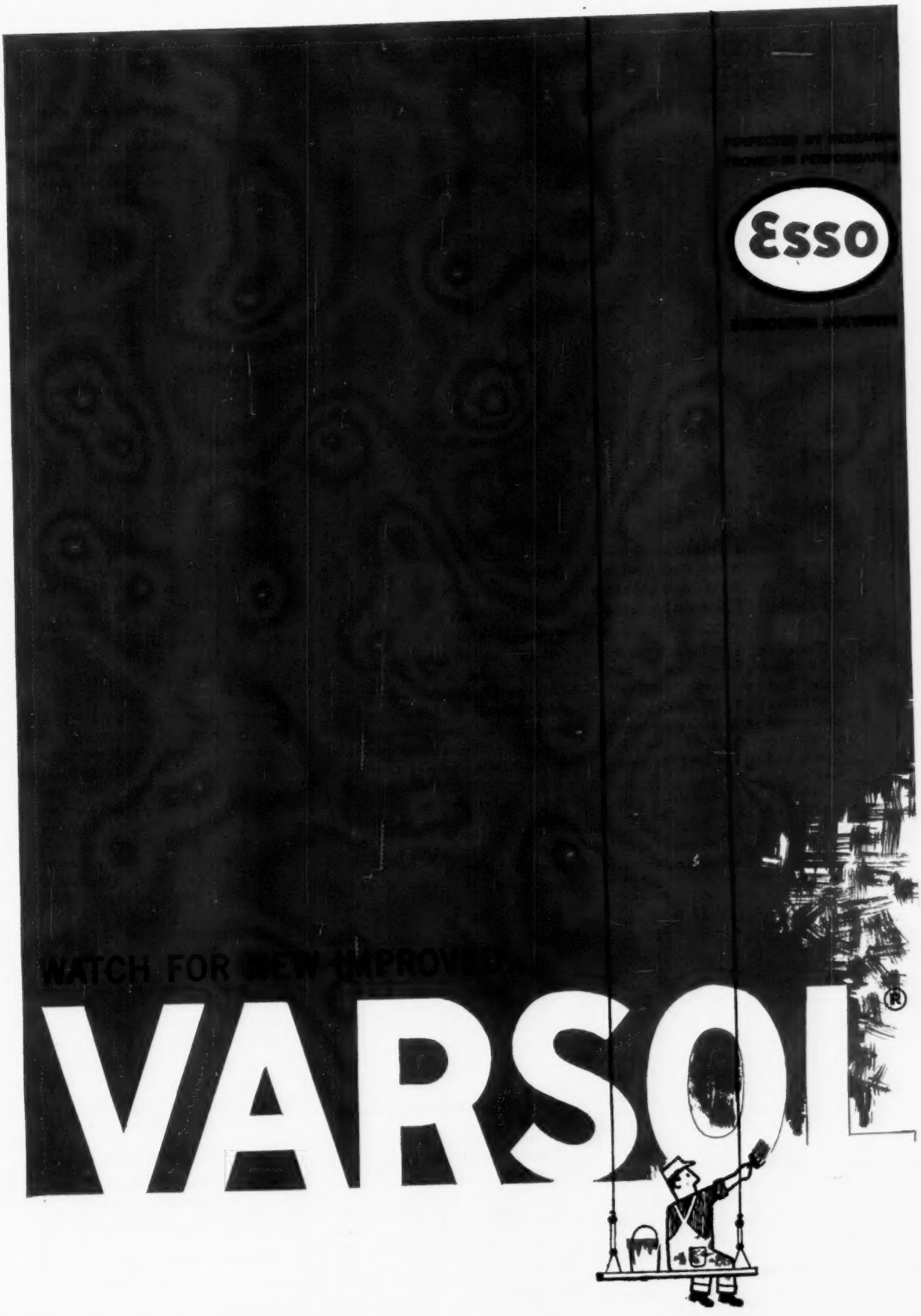
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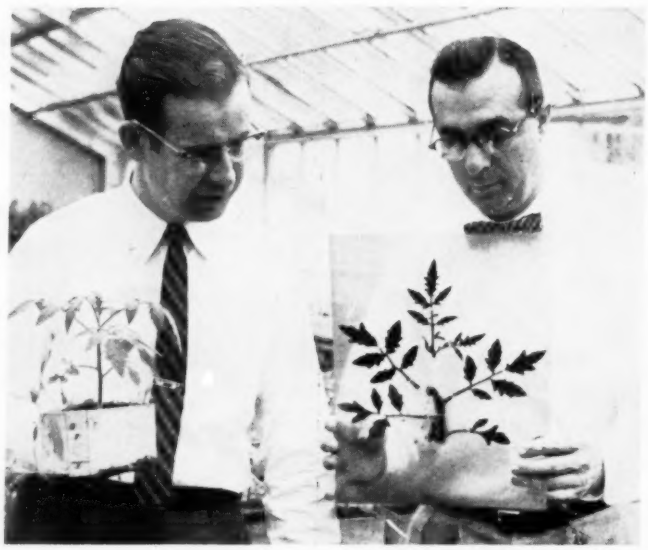

Chemical Tranquilizers Take on the Plant World

Examining a radio-autograph of a tomato plant which has been sprayed with "tagged" Duraset-20W, N-meta-tolyl phthalamic acid, are discoverers of the new chemical Allen E. Smith, left, and Albert W. Feldman of U. S. Rubber.

Dubbed a chemical tranquilizer for plants, it increases plant yields by reducing effects of shock and stress caused by such conditions as heat spells, sudden cold, prolonged rain.

Field tested on lima beans, cherry and pineapple-orange trees and cotton plants, it has increased yields from 10 to 90%. It will be marketed for use on some crops for the first time this season.—U. S. Rubber Co., New York, N. Y. 68A

such methods as spraying or roller coating, and processing under controlled conditions of temperature and atmosphere. The resultant coloring is durable, and chemically and physically resistant to most conceivable environments where the process could be employed.

The Permyron process is unique in that parts can be severely formed after coloring without impairing the surface and extremely large parts such as architectural panels can be processed. In addition, it is expected that this superior coloring will be produced at less cost than other coloring processes. It also shows promise for the coloring of aluminum, plain carbon steels, and other metals, and will ultimately be available in a range of colors.

It will be licensed to the trade on a non-exclusive basis. — **Electro Metallurgical Co., New York, N. Y. 66C**

Glass-Reinforced Foam

Now foams may join plastics benefitting from glass fiber.

The relatively unknown team of plastic foam and glass fibers have been undergoing tests conducted jointly by National Aniline Div. and Owens-Corning Fiberglas Corp. Adding variously sized and coated glass fibers to urethane foams has increased resilience, compression set and compressive strength, reduced percent elongation. Sample results:

	Untreated	Glass Added
Elongation, %	515	220
Compression Set, %	19	5
Compression Strength, %	0.46	0.64
Resilience, %	15	22

Analysis of tests indicates that when one specific property of a foam is to be improved, a glass fiber of suitable length, coating, and percentage in the final formulation can generally be found. However, changes in other physical characteristics must also be checked to be certain they have not exceeded useful limits.

Principal components of the test foams were Nacconate 80 isocyanate of National Aniline, Plaskon PFR-4 polyester from Barrett Div. and glass fiber and binders supplied by Owens-Corning. — **National Aniline Div., New York, N. Y. 68B**

BRIEFS

Amino triazole, described as the first chemical herbicide to give outstanding kill of both tops and roots of Canada thistle, has just been approved by FDA for use on corn. It is expected to save several hundred million dollars per year in corn growing states.—**American Cyanamid Co., New York, N. Y. 68C**

Rigid polyethylene Fortiflex A-250 (melt index 2.5) has been introduced for intermediate-size injection molded products. Price, like that of older member of the Fortiflex series, is 43¢/lb. — **Celanese Corp. of America, New York, N. Y. 68D**

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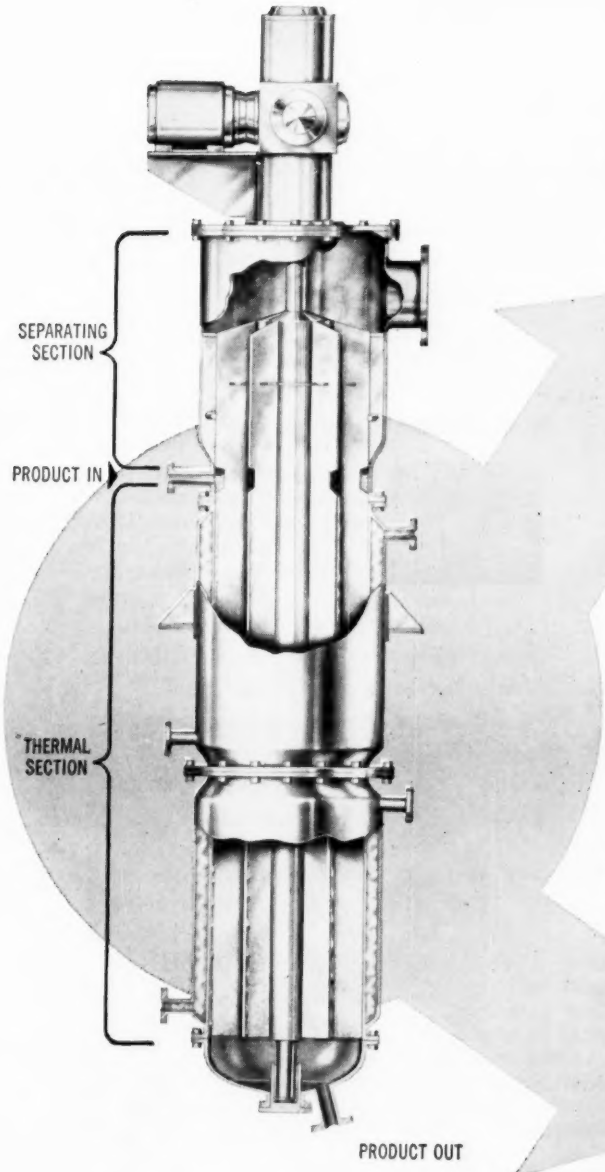

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Short-time exposure and minimum hold-up of the process fluid in the thermal section assures uniform heat and mass transfer, even at high temperature. Foaming is controlled by a mechanical separator and the formation of crust is minimized permitting continuous operation for long periods.

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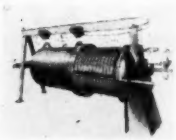
Redesigned Pressure Filter **70A**



Permits choice of filter media, simplifies removal of bridged cakes.

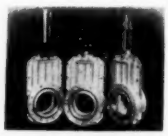
Form-Fitting Heating Elements **70B**

Ceramic-encased resistance heating element molded to fit equipment contours.

Lightweight Fire Suit **72A**

Donned in only a few minutes, suit protects wearer in direct flame.

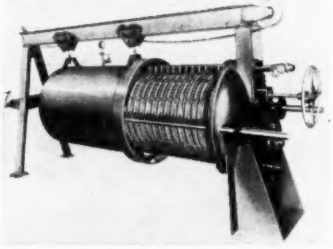
High-Vacuum Gate Valves **72B**



Valve construction gives long-lasting tight seal in vacuum service.

Shutoff coupling connects and controls flow.....72C
Pyrometer measures low surface temperatures....72D
Cleaning service fills in-place cleaning needs...72E
Continuous sterilizer uses ultraviolet light.....74A
Super-lift hoist has 0.008-in. precision.....74B
Safety wheel stop blocks rail cars.....74C
Preamplifier ups low-level d.c. signals.....74D
Glassed flush valve costs same as steel.....76A
Plastic blanket seals against vapor loss.....76B
Scrubber operates up to 15,000 psi.....76C
Analog-to-digital converter is now available.....76D
Expansion joints and couplings come in Teflon....76E

For more details use Reader Service Card



Pressure Filter

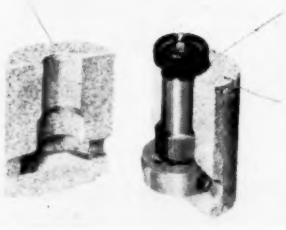
Redesigned leaf assembly gives new versatility.

New advances in leaf-assembly design enable Shriver to eliminate two major drawbacks of conventional vertical-leaf pressure filters. Gone from their new filter is the limitation on the kind of filtering medium that may be used. And, removal of any cake bridged between the leaves is greatly simplified.

The new leaf assembly consists of a series of alternating leaves and frames suspended from horizontal bars. Desired filter media clamps between the machined rims of these leaves and frames.

Or, if the process calls for precoat operation, gasketed spacers replace the frames; in this case, wire mesh of the leaves acts as filter medium. If cake bridging occurs, loosening of the follower permits leaves to be separated for dumping.

Circular leaves each have 12 sq. ft. of filtering area. Available with total areas from 150 to 450 sq. ft., filters come in stainless or carbon steels. — **T. Shriver & Co., Inc., Hamilton St., Harrison, N. Y. 70A**



Heating Element

Form fitting insures maximum heat transfer.

First designed for atomic energy plants, Thermoshell form-fitting electric heating elements now offer general industry the means for quick and efficient heat transfer to valves, pipes and other process equipment.

Consisting of properly spaced resistor wires embedded in a

Take a New Look at

TITANIUM

Wonder metal? Restricted supply? Not today. Titanium is daily *proving* its economic advantages in more and more industrial applications.

And Mallory-Sharon...world's largest integrated producer of special metals... is ready *now* to assist you in designing with titanium. We can supply your requirements for titanium and titanium alloy sheet, strip, rod, bar, plate and other mill products...many of them from stock.

Check below for ways titanium and its alloys can serve you now! Then write us about your requirements, or contact our nearest sales office.

For availability – *Delivery time on titanium has been cut by Mallory-Sharon's ingot inventory in certain grades and analyses. Here, orders can be started in the ingot stage, saving time for fabricators. In addition, a wide range of sheet and bar sizes can be shipped direct from stock.*

For corrosion resistance–*Turbine impeller made from titanium has given four years' service in highly corrosive application that killed other metals in weeks or even hours. Impeller agitates slurry containing cobalt, nickel, copper arsenic, iron and sulfuric acid.*

For high strength-to-weight–*In the U.S. Air Force's B-58 Hustler, built by Convair, Fort Worth, heat-treated titanium alloy was substituted for alloy steel–for wing fittings bearing heavy loads. Result: 44% saving in weight, with strength equal or superior to the previous material.*

For technical facts *write for "Titanium Fact File"–giving advantages, metallurgy, corrosion properties, information on machining, welding, forming. Our Service Engineering group is ready to assist you.*

See our 4-page ad in Chemical Engineering Catalog, Pages 1147-1150, for additional technical information.

MALLORY-SHARON

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Integrated producer of Titanium • Zirconium • Special Metals

ceramic molding, Thermoshells offer several advantages in comparison with other heating elements. Heat distributes uniformly over the entire area being heated. Resistor wires remain permanently in position, thus preventing the development of localized "hot-spots." And, the close-fitting design of the unit results in the maximum possible heat flow between element and the item being heated. **—Cooley Electrical Mfg. Corp., 38 South Shelby St., Indianapolis 7, Ind. 70B**

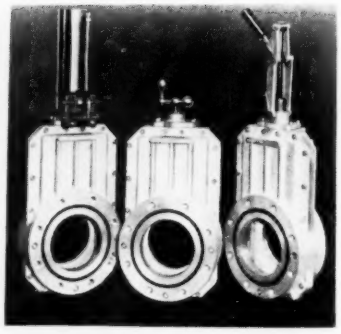
Fire Suit

Safety clothing protects wearer from direct flame.

A new aluminized-asbestos fire suit, which has been tested at temperatures of over 2,000 F., offers full protection to wearer, even in direct flame.

The suit's heat resistance stems from its multilayer construction. The inner layer consists of two linings of glass-fiber cloth treated with neoprene; the middle layer of a 1-in.-thick glass-fiber insulation bonded to aluminum foil. Outer layer is aluminized asbestos.

Manufacturer claims that the suit can be easily donned in less than 2 min. Other features include extreme pliability and light weight. Helmet, jacket, trousers, shoes, mittens and carrying case total only 23 lb. **—Safety Clothing and Equipment Co., 1990 East 69th St., Cleveland, Ohio. 72A**



High-Vacuum Valves

Ideal for small-space installations.

The new ST series of high-vacuum gate valves, which may be installed in any position, seals vacuum-tight against atmospheric pressure in either direction. Other features include full-opening design and a short, unrestricted flow path.

Key to the valve's long-lasting tight seal is a special valve-plate guiding mechanism. Special rollers and a follower carriage with hinged links control plate motion to prevent scuffing of the gate-sealing gasket.

Valves come with either of three types of operating mechanisms: pneumatic, handwheel or quick-acting toggle lever. Stock sizes include 2, 3, 4 and 6 in.; larger sizes are made to order. — **Vacuum Equipment Div., F. J. Stokes Corp., Tabor Rd., Philadelphia Pa. 72B**

Shutoff Coupling

May find acceptance in general industry.

With a long record of successful use as a quick, safe connector of fueling lines to diesel locomotives, the Aeroquip Fueling Coupling is now available for industrial applications.

Essentially, the coupling consists of two halves, each containing a spring-loaded valve. One half mounts on process equipment or pipelines, the other on a flexible hose, which in turn connects to other equipment.

The act of coupling the halves opens both valves, and flow starts; uncoupling stops flow.

Chief advantage of the coupling is its ability to connect and control flow simultaneously, with no hazardous or wasteful spillage. Offered in several sizes and materials, couplings are acceptable for vacuum or pressure service with clear liquids or light slurries.—**Aeroquip Corp., 300 South East Ave., Jackson, Mich. 72C**

Pyrometer

Now available for low-temperature operations.

The Ardonox, claimed to be the first commercial total-radiation pyrometer of its kind, measures surface temperatures from below freezing up to 1,100 F. Accuracy is ± 1 F. Neither color, transparency nor surface finish affect reliability of results.

Sensing element of the unit is a tiny, 23-junction thermopile located at the focal point of a concave mirror. Total energy radiated from a body under study focuses on the thermopile, where it generates a voltage proportional to the body's surface temperature.

Thin plastic foil, which transmits all infrared radiation, seals the instrument's case. A circuit of temperature-sensitive resistors compensates for effects of ambient-temperature changes.

Ardonox comes complete with a Wheelco indicating recorder-controller. Combined unit response time is about 1 sec.— **Velotron, Inc., 1186 Broadway, New York 1, N. Y. 72D**

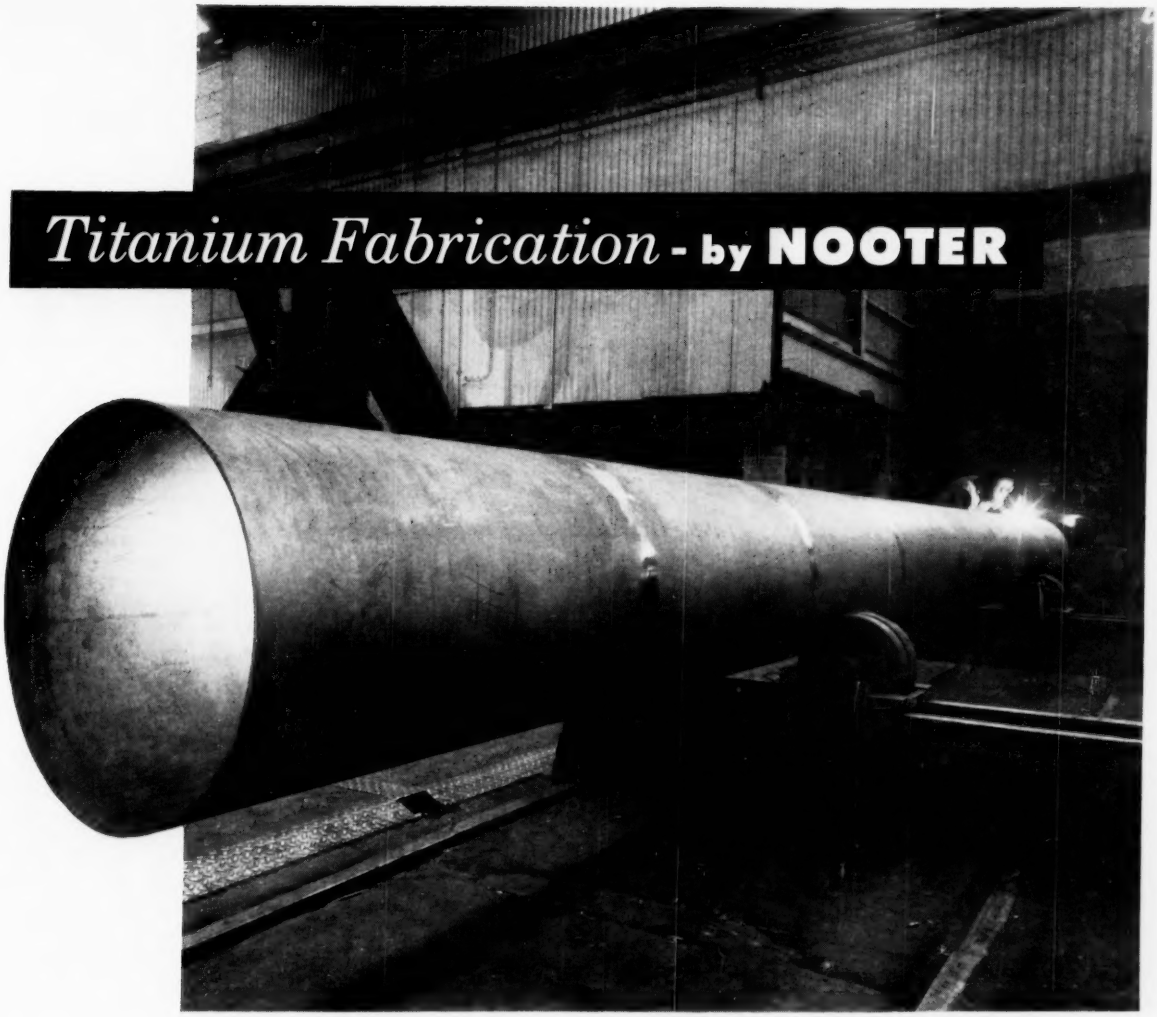
Cleaning Service

"Package" rig serves in-place cleaning needs.

Claimed to be the first of its kind, Kelite's trailer-mounted rig is fitted out for all phases of in-place cleaning of process equipment. The complete service also provides all technical manpower and supervision needed for proper rig operation.

In particular, the service is most useful in filling the chemical-cleaning needs on the product side of petroleum-refining

Titanium Fabrication - by NOOTER



And the Rare Earths . . . can be put effectively and precisely to work for you by Nooter.

The rare earths . . . zirconium, tantalum, titanium. Metals with the capacity to withstand high temperatures and to resist corrosion. Metals with these and other special capabilities to meet the ever-increasing special demands of our very special age. And now at your disposal . . .

Nooter can and is now welding any type of zirconium, tantalum, or titanium plate fabrication . . . with single or multiple pass welding, fully X-rayed. In titanium work, the metal can be either commercially pure, or in some alloyed forms.

The welding and fabrication of these new metals is a pioneering task, exacting the highest skill and ingenuity from those who would unlock and put to use their special capabilities. It is not a new role for Nooter, with more than a half-century of experience as a custom fabricator. Through continuous, painstaking and imaginative metallurgical, fabricating, and welding research, Nooter over the years has led the way in developing techniques for working and welding many new metals and alloys.

And now...the RARE EARTHS! When they fit your needs, let Nooter put them to work for you.

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Steel and Alloy Plate Fabricators and Erectors . . ."Boilermakers"

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and petrochemical equipment. Typical apparatus on a mobile unit includes a 500-gpm. pump; a 2,500-gal. surge tank for acid, alkali or solvent; 300-gph. gas- or oil-fired steam cleaners; fireless steam cleaners; and Powerblast units having a 60-gpm. output of 300-psig. water.

Chemicals available include inhibited descaling compositions, solvent-acid and solvent-alkali compositions, and solvent emulsions.

Kelite now has two rigs in service, one for the Gulf area and the other for California. Plans call for additional rigs in the near future, one for the Chicago area and the other for New Jersey.—**Kelite Corp., 81 Industrial Rd., Berkeley Heights, N. J.** 72E

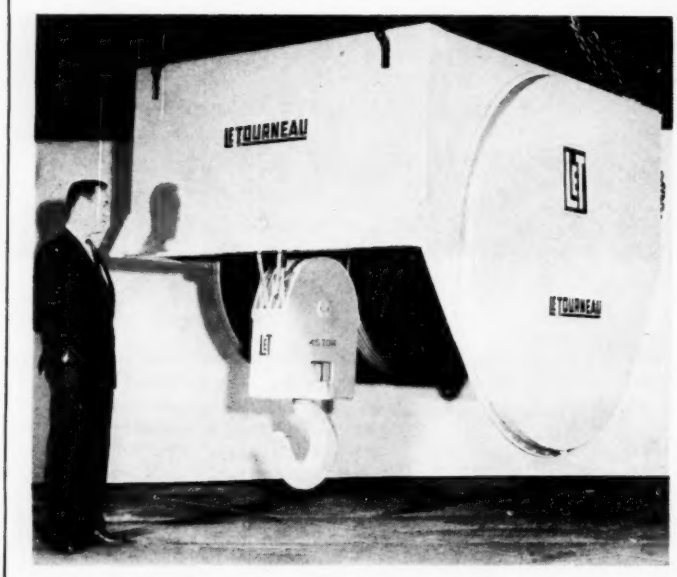
Continuous Sterilizer

Unit for production or research now available.

The Centrifilmer, a centrifugal filming machine now in production, continuously sterilizes sensitive biological fluids and liquid foods.

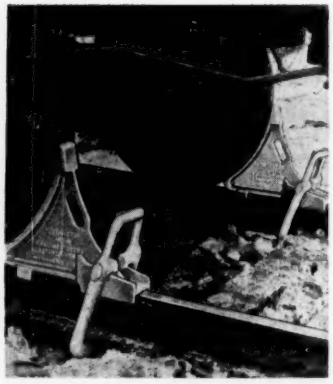
In operation, the machine irradiates a thin, centrifugally formed liquid film with ultraviolet light. Precise control of this procedure inactivates a variety of micro-organisms.

Typically, the unit is now processing polio vaccines and blood plasma on a commercial basis.—**Spinco Div., Beckman Instruments, Inc., Stanford Industrial Park, Palo Alto 25, Calif.** 74A



Super-Lift Hoist Has Needle-Threading Precision

Recently sold to a chemical manufacturer at Pensacola, Fla., this Texas-size hoist has colossal capabilities. To quote a LeTourneau engineer, it "could lift 20 full-grown elephants to the height of an 8-story building—and as gently as a mother lifts a baby from its crib." More specifically, the hoist's capacity is 45 tons, its lift height is 103 ft. and it can move a full load with a remarkable precision of 0.008 in.—R. G. LeTourneau, Inc., 2399 South MacArthur, Longview, Tex. 74B



Safety Wheel Stop

Unique safety device holds rail cars in place.

The Porta-Stop wheel stop provides a handy means for wheel-blocking rail cars anywhere on the track—and releasing them as easily.

A 30-deg. revolution of each of the twin interlocking clamp handles secures the wheel-conforming block to the rail. Two clamp styles are available—one for rails up to the 110-lb. class, the other for above 110 lb. Wheel blocks fit all rails.

Weight of each Porta-Stop, complete with clamp, is about 60 lb.—**Calumet Steel Castings Corp., 1636 Summer St., Hammond, Ind.** 74C

Preamplifier

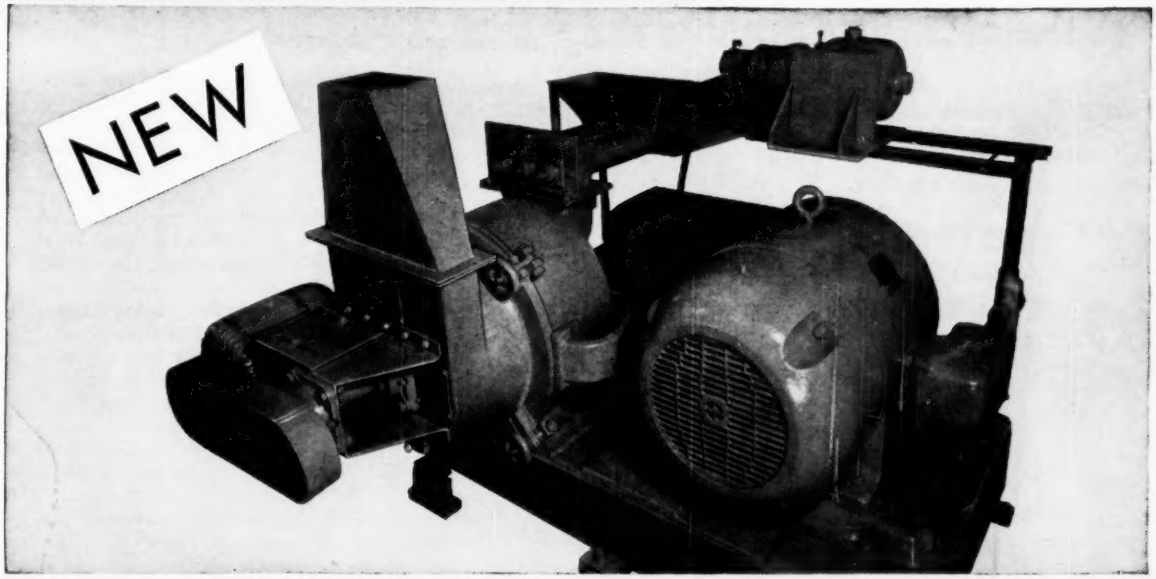
Boosts signals to high-speed potentiometer.

Features offered by the Honeywell Model 2HLA-7 preamplifier include an isolated differential input, gains up to 100,000, 20-cps. frequency response and 1 microvolt noise and drift.

The preamplifier is most valuable for raising low-level d.c. signals to a range suitable for input to Honeywell and other high-speed, circular or strip-chart potentiometers. For instance, differential-thermocouple signals as low as 20 microvolts could be boosted by the preamplifier to produce full-scale deflection on a 12-in. chart potentiometer.

An integral voltage divider provides a standard 10-millivolt full-scale output signal; out-

NEW PRODUCT NEWS



FOR PRECISION GRINDING AND CLASSIFYING IN ONE OPERATION

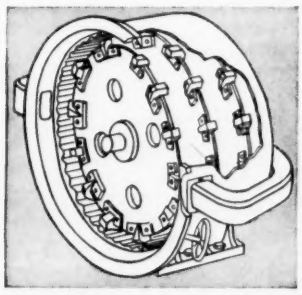
The PULVOCRON . . .
An Air Attrition Impact Pulverizer and Classifier with Controlled Radial Inward Air Classification.

Now in one compact unit you can have a pulverizer and a classifier plus an automatic feeder, with separate controls over each. This assures positive particle size control and high capacity over a wide range of products. The Pulvocron will produce particle sizes from a range of 99% less than 5 microns or as coarse as 50 mesh, depending on the material and desired results.

The grinding chamber contains three adjustable plates with twelve staggered beaters on each. It also features added versatility through interchangeable liners of corrugated, perforated or smooth finish, plus variable rotor stator clearances.

The Classifier unit is on a hinged section with quick-open locks for simplicity of operating adjustment or cleaning.

Material is both ground and classified through high centrifugal pressures set up by the beater and classifier plates. The Pulvocron is designed with oversize returns for automatic feed back of any oversize for further grinding.



Grinding chamber with adjustable plates, removable liners and oversize returns.

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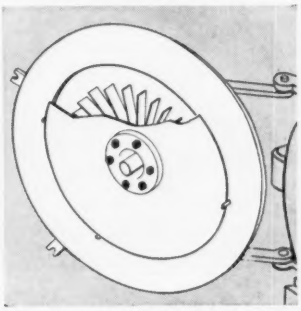

Classifier Unit with separate motor. Swings open as a hinged section with quick open locks.

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The **Strong Scott** Mfg. Co.

DEPT. CE-NPB6-645

Equipment Designed for Better Processing

451 TAFT STREET N.E., MINNEAPOLIS 13, MINNESOTA

put without voltage divider is 10 v. for rated inputs. Unit mounts on either panel or bench. —**Minneapolis-Honeywell, Boston Div., 1400 Soldiers Field Rd., Boston, Mass.** 74D

Glassed Flush Valve

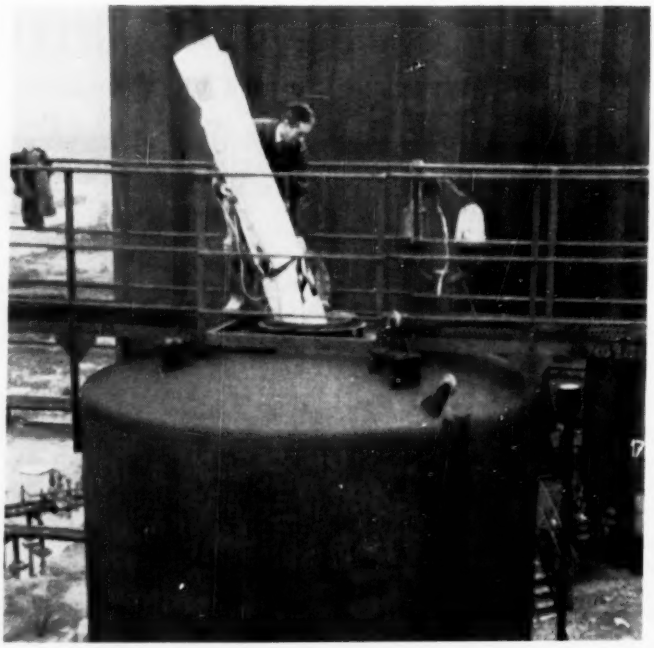
Designed to fit standard glass-lined reactors.

A new line of all-glass, interior flush valves, recently introduced by Pfaudler, is available for field installation on glassed-steel reactors in pressure or vacuum service.

The one-piece glassed head and stem, together with a glass-filled Teflon seat, keeps maintenance requirements low. This design also insures low product buildup at the head between batches.

Valve glass is resistant to all acids, except hydrofluoric, at elevated temperatures and pressures; it also resists attack by alkalis at moderate temperatures.

Valves come in six sizes ranging from ½/1 in. to 8/6 in. (I.D. inlet/outlet). Prices are comparable with stainless steel.—**Pfaulder Co., 1064 West Ave., Rochester, N. Y.** 76A



Major Offensive About to Start Against Vapor Loss

Looking much like a big cigar, a rolled-up, flexible plastic blanket is shown ready for installation inside a 25-ft.-dia. gasoline-filled tank. Claimed to cut evaporation losses by over 90%, these polyvinyl chloride floating seals come in sizes ranging from 10 to 100 ft. In addition to curtailment of vapor loss, the blankets offer considerable protection against fire hazards. Although relatively new to the United States, they have long proved their value at over 125 major European installations. —Devys & Lobo, 124 East 40th St., New York 16, N. Y. 76B

BRIEFS

Scrubber, the Hi-eF Type LDW, obtains exceptionally high recoveries of dust from natural gas. Standard models operate up to 1,000 psig.; models for service up to 15,000 psig. are available on application. —**V. D. Anderson Co., 1935 West 96th St., Cleveland, Ohio.** 76C

Analog-to-digital converter has a speed of 6,000 independent conversions per second. Operating at rates of 100,000 bits/sec., transistorized unit offers 0.05% accuracy. —**Fischer & Porter Co., Jacksonville Rd., Hatboro, Pa.** 76D

Teflon expansion joints and flexible couplings now come in 12 sizes each to fit pipe from ½ to 12 in. dia. Expansion joints have 4 convolutions. **Sentinel Glass Co., Hatboro, Pa.** 76E

Equipment Cost Indexes

	Sept. 1957	Dec. 1957
Industry		
Avg. of all	225.0	220.7
Process Industries		
Cement mfg	216.6	220.7
Chemical	226.6	230.4
Clay products	210.4	214.4
Glass mfg	214.0	217.6
Paint mfg	217.4	221.6
Paper mfg	218.3	222.0
Petroleum ind	222.0	226.3
Rubber ind	224.8	229.1
Process ind. avg	223.7	227.0
Related Industries		
Elec. power equip	229.8	232.9
Mining, milling	228.0	231.8
Refrigerating	254.0	258.9
Steam power	212.8	216.9

Compiled quarterly by Marshall and Stevens, Inc. of Ill., Chicago, for 47 different industries. See Chem. Eng., Nov. 1947, pp. 124–6 for method of obtaining index numbers; Feb. 24, 1958, pp. 143–4 for annual averages since 1913.

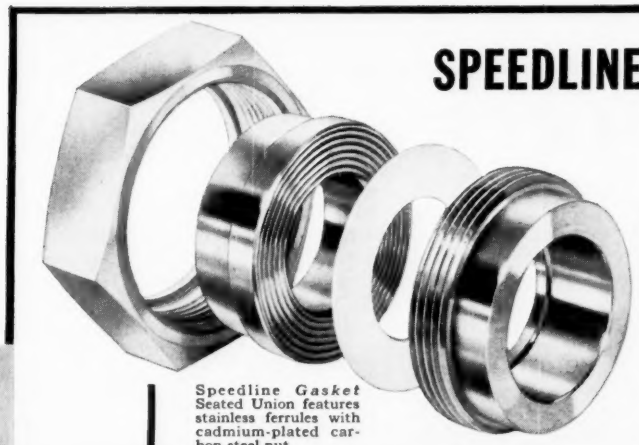
For More Information . . .

about any item in this department, circle its code number on the

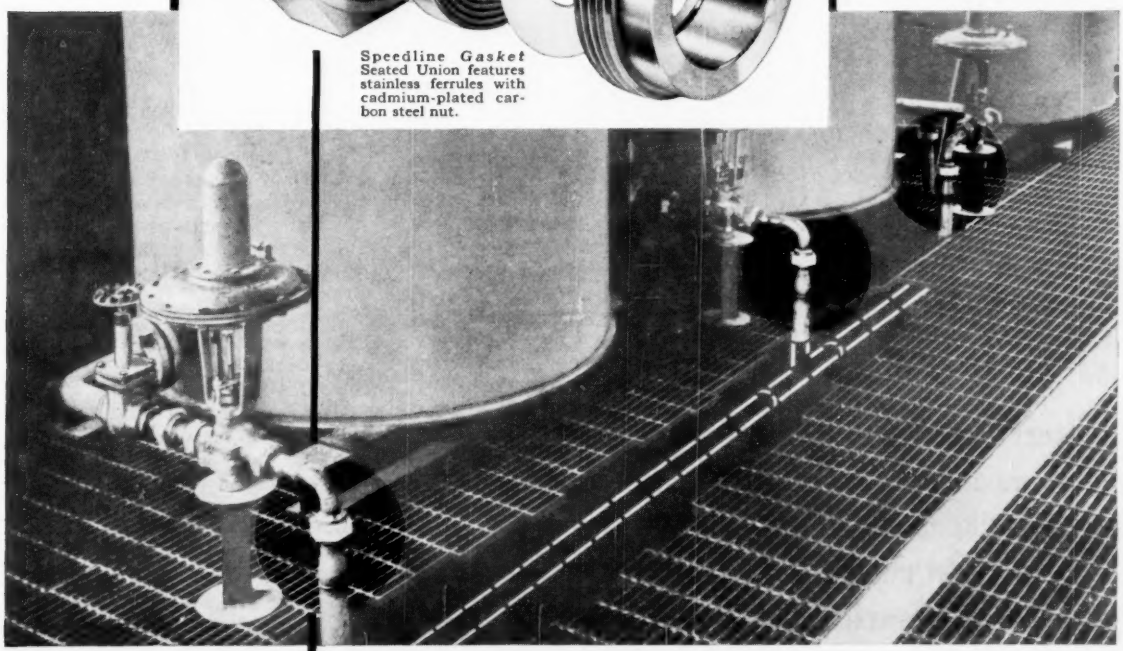
Reader Service

postcard (p. 203)

SPEEDLINE FITTINGS SOLVE LEAKAGE AND ASSEMBLY PROBLEMS



Speedline *Gasket* Seated Union features stainless ferrules with cadmium-plated carbon steel nut.



Here's the stainless steel union to eliminate troublesome ground joints. The Speedline Union is *gasket seated* to eliminate leakage . . . *bi-metallic* to permit easy disassembly and make-up *without* galling or seizing. It's available in two styles . . . for welding or expanding to low cost Schedules 5 and 10 pipe and the complete line of Speedline fittings.

Advantages of Speedline Unions simplified piping problems at American Alcolac's Baltimore plant . . . permits ready removal of process lines located beneath floor grating when necessary. Use of Speedline Fittings throughout the plant's piping system reduced labor and materials costs to a minimum . . . maintained high degree of process purity demanded in process operations.

The *complete line* of Speedline Fittings with the exclusive "extra length" feature, offer many assembly advantages and cost savings not possible with conventional fittings. Request your copy of Speedline Catalog today.

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PETROCHEMICALS IN '58

More Aromatics From Petroleum

Steel's present slump means less coke, less coal chemicals —and a sweet chance for refiners to swell oil's share of aromatics markets.

James W. Bradley, Robert L. James and Richard E. Messing, Arthur D. Little, Inc., Cambridge, Mass.

The petroleum route to aromatic chemicals—already providing a growing share of U. S. requirements for benzene, toluene and xylene (BTX)—has a new opportunity to win friends and influence people. The open door: the present slump in steel which has forced output well under 60% of capacity and trimmed yields of coking chemicals.

Demand for BTX chemicals is down, too—but not as much as the need for steel. Hence, petroleum sources are being tapped to fill industry's tanks with benzene, toluene and xylene.

Even if coal chemicals regain their full pre-recession share of markets, sales of petroleum BTX will have been livelier for a year.

As for the long range view, petroleum aromatics seem headed inevitably for bigger pieces of chemical markets.

Recovery of BTX from coking is a byproduct operation and limited to the level of steel production. No increase in light oil per ton of steel is foreseen; improved steel-making technology may even reduce coke requirements per ton of steel.

▶ **Oil Aromatics Unlimited**—In sharp contrast to this situation is the small fraction of available aromatics actually separated from petroleum streams (most aromatics wind up in gasoline). Separation takes place at only a few refineries, although several large units are now abuilding.*

Another advantage of the petroleum route is its ability to produce relatively pure materials well suited to synthesis of materials like plastics, detergents and insecticides. Aromatics derived from coking of coal, and purified by the traditional acid wash, are higher in sulfur content and generally of lower quality.

▶ **Purer Coal Chemicals** — Some coke oven producers are answering back by refining their products more thoroughly. Jones & Laughlin has installed more than $2 million worth of BTX purification facilities to produce better aromatics. Process involves hydrogen treatment to remove sulfur compounds, followed by Udex extraction and fractionation. U. S. Steel has also adopted petroleum refining methods and will follow a similar route.

Capacity of these two new units is more than 50 million gal. of BTX a year.

One of the factors most heavily in favor of coal chemicals is the awkward product mix obtainable via the petroleum route to BTX: Toluene and xylenes make up the majority (toluene more than 40%); content of benzene, the most wanted chemical, normally runs below 20%.

Coloring the whole picture, of course, are demands for aromatics in gasoline. Increased use of jet fuels rather than avgas tends to increase availability of petroleum aromatics for chemical use. But the trend to higher octanes for automotive gasoline is accelerating competition between motor fuel and chemicals.

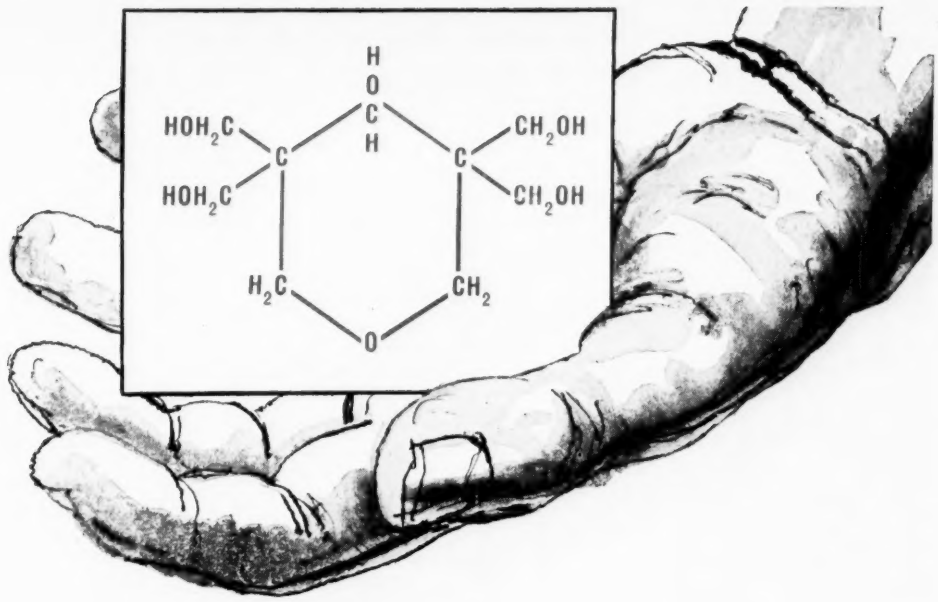
▶ **Benzene Is the Most**—Benzene has the greatest unit value of the three common aromatics. It makes up nearly 80% of the high-boiling product from coal tar; toluene accounts for about 20% and xylene for much less.

Most benzene goes to styrene (*Chem. Eng.*, Jan. 27, 1958, pp. 95-96) and phenol. Talk of expansion in phenol capacity may be academic in view of the current excess capacity. Estimated 1957 production of phenol was 524 million lb. vs. a capacity of about 670 million lb. (see p. 82).

The relatively mature phenolic resins remain the largest single end use, while the alkyl phenols and 2,4-D together consumed over 10%.

▶ **"Natural" Ethylbenzene** — More than 40% of the benzene output is consumed in the synthesis of ethylbenzene, an intermediate that figures in better than 95% of the nation's styrene capacity. However, catalytic reforming produces, in addition to BTX, significant quantities of

* Major producers of BTX from petroleum include Shell Oil, Suntide Refining, Sun Oil, Standard Oil of California, Standard Oil of Indiana, Delhi-Taylor, Gulf Oil and Humble Oil Refining.



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Four primary and one secondary hydroxyl groups... a stable 6-membered ring containing oxygen... the chemical structure of Celanese Anhydroenneahepitol suggests a wide range of application possibilities for this new low-cost polyol.

Alkyd resins, surfactants, pharmaceuticals, explosives, drying oils, are just a few typical examples.

Developed by Celanese research and produced by aldol condensation process, anhydroenneahepitol is currently available in experimental quantities in aqueous solution. Evaluate this new Celanese intermediate yourself... find out how it can contribute to lower cost and higher quality in your formulations. Celanese Corporation of America, Chemical Division, Dept. 553-E 180 Madison Avenue, New York 16, N. Y.

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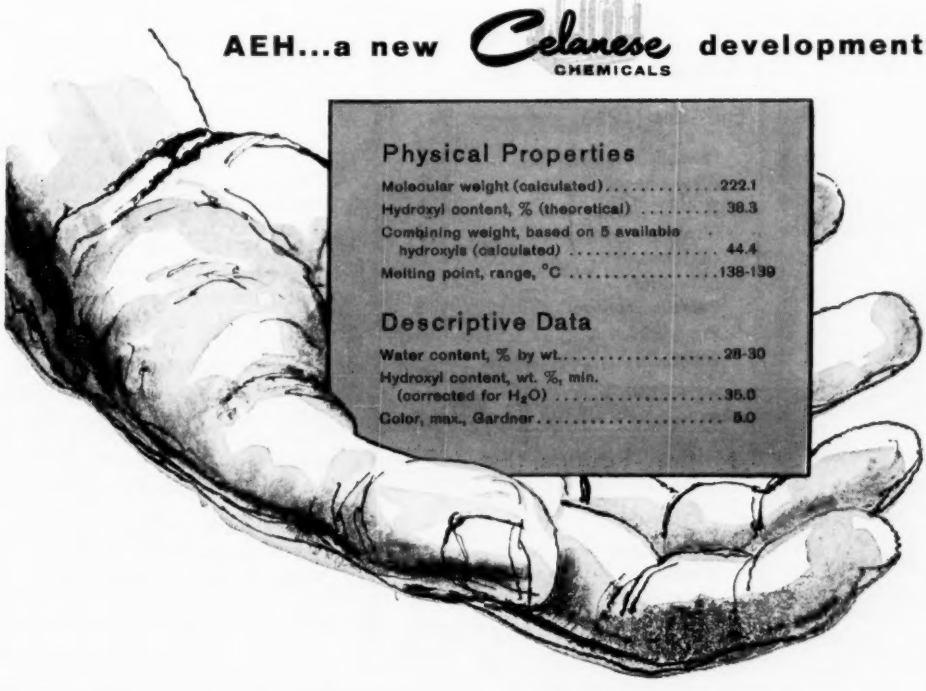


Physical Properties

Molecular weight (calculated)	222.1
Hydroxyl content, % (theoretical)	38.3
Combining weight, based on 5 available hydroxyls (calculated)	44.4
Melting point, range, °C	138-139

Descriptive Data

Water content, % by wt.	28-30
Hydroxyl content, wt. %, min. (corrected for H_2O)	35.0
Color, max., Gardner	5.0

BENZENE: Styrene is the bellwether

Production (1957): 326 Million Gallons (Est.)

Sources (1956)	%
Coke ovens	51.8
Petroleum	33.2
Tar distillers	15.0

End-Uses (1956)	%
Styrene	41.2
Phenol	20.8
Synthetic detergents	6.5
Aniline	4.5
DDT	4.6
Benzene hexachloride	2.5
Other	19.9

TOLUENE: Needs new chemical uses

Production (1957): 204 Million Gallons (Est.)

Sources (1956)	%
Petroleum	75.4
Coke oven	21.4
Tar distillers	3.2

End-Uses (1956)	%
Motor fuel	23.5
Aviation gasoline	24.8
Explosives	8.1
Chemical synthesis	11.3
Paint, varnish and lacquer solvents	11.2
Export	4.4
Other	16.7

XYLENES: Separate isomers wanted

Production (1957): 145 Million Gallons (Est.)

Sources (1956)	%
Petroleum	91.0
Coke oven	7.6
Tar distillers	1.4

End-Uses (1956)	%
Coatings and solvents	47.8
Aviation gasoline	29.4
Isomer separation	11.0
Other	11.8

PHENOL: More and more from cumene

Production (1957): 524 Million Pounds (Est.)

Sources (1956)	%
Benzene	75.8
Cumene	17.1
Natural byproducts	7.1

End-Uses (1956)	%
Phenolic resins	43.7
Alkyl phenols	6.9
2, 4-D	4.7
Bisphenol	4.4
Cyclohexanol	1.8
Salicylates	1.3
Pentachlorphenol	1.3
Export	7.6
Misc.	28.3

PHTHALIC ANHYDRIDE: Coal still king

Production (1957): 347 Million Pounds (Est.)

Sources (1956)	%
Naphthalene	95
o-Xylene	5

End-Uses (1956)	%
Alkyd resins	44.5
Plasticizers (phthalates)	31.7
Polyesters (unsaturated)	4.8
Dyestuffs	4.1
Misc.	14.9

ethylbenzene. Should new styrene plants be based on reformate ethylbenzene, future benzene production from reformate would be adversely affected.

Benzene's other chemical uses require a high-purity grade of material: synthetic detergents, aniline, pesticides.

Synthetic detergents based on dodecyl benzene are well established. Yet no sulfonated alkyl toluene or alkyl xylenes have proven satisfactory, although sulfonated toluene and xylenes are used as coupling agents.

Aniline's major outlets are rubber chemicals (60%), dyes and pigments, drugs and photographic chemicals—mostly hydroquinone. Most aniline production is by direct hydrogen reduction of nitrobenzene, as practiced by American Cyanamid and Allied Chemical & Dye. Du Pont has announced construction of a new plant based on this process.

Dow manufactures aniline by ammonalysis of monochlorbenzene. Several older steam-and-iron nitrobenzene reduction plants, including those of Du Pont and U. S. Rubber, are believed still operating.

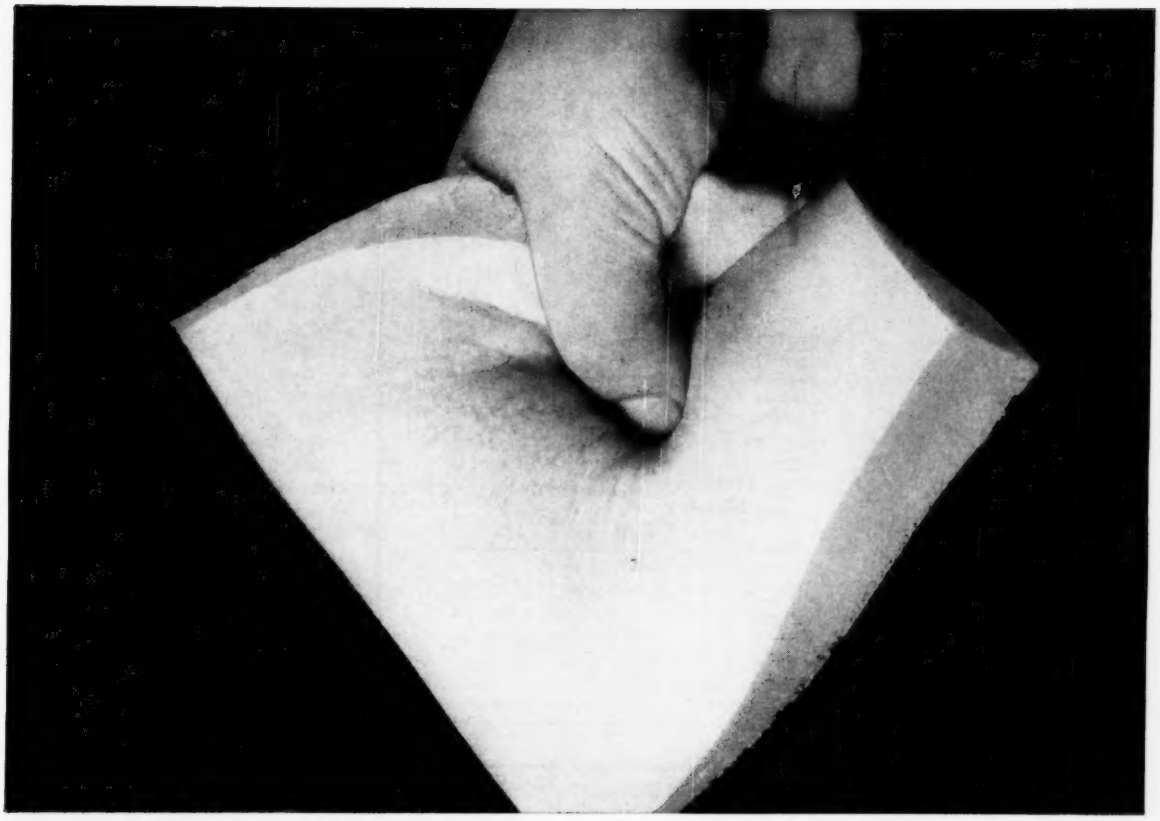
Aniline production in 1957 was 113 million lb.

► **DDT, BHC Still Big** — DDT continues as a popular wide-band insecticide. In 1957 124 million lb. were produced (from monochlorbenzene). Another insecticide, benzene hexachloride (BHC), is produced by chlorination of benzene. Only the gamma isomer (lindane) is active.

Benzene production figures, unlike those for toluene and xylenes, don't include material used in motor fuel. This usage is not large, however, since benzene is far more valuable for chemical and solvent purposes.

There's a real interest in higher homologs of benzene, particularly pseudocumene (trimethyl) and durene (tetramethyl). Their corresponding alcohols and acids are expected to find uses in resins, plasticizers and coatings. Shell, along with several other refiners, has been active in promotion of durene.

► **Fuels Need Toluene**—Most of the toluene produced still goes to motor fuel and aviation gasoline, although requirements for syn-



Good compression—is one advantage of polyether-based polyurethane foams made from new NIAX Diol PPG 2025. In addition, it helps give foams that are lower in cost than other types of flexible foams.

Now—Lowest cost Polyurethane Foams

from NIAX Diol PPG 2025

TRADE-MARK

(POLYPROPYLENE GLYCOL 2025—RESIN GRADE)

Lowest cost you say? Right! Polyether-based foams, from NIAX Diol PPG 2025 are lower in cost than other types of flexible foams. Therefore, if you are making prepolymer or foam, you'll want to take advantage of NIAX Diol PPG 2025. This new material assures uniform properties of the prepolymer or foam—from batch to batch.

In addition to imparting good compression—deflection characteristics, resilience, and recovery properties, field tests show NIAX Diol PPG 2025 gives the added advantage of excellent humid-aging.

Union Carbide Chemicals Company's NIAX Diols PPG 425, 1025, and 2025 also are bases for other types of flexible and rigid urethane foams.

For samples and specification data on these products, write Union Carbide Chemicals Company, Room 328, Department H, 30 East 42nd Street, New York 17, New York.

In Canada: Carbide Chemicals Company, Division of Union Carbide Canada Limited, Montreal.

UNION CARBIDE

CHEMICALS

Union Carbide Chemicals Company
Division of Union Carbide Corporation
30 East 42nd Street, New York 17, N. Y.

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PHENOL CAPACITY: More than enough

Producer	Location	Capacity (Million Lb.)
From Benzene		
Allied Chemical & Dye	Frankford, Pa	12
Dow Chemical	Midland, Mich.	220
Hooker Electrochemical	North Tonawanda, N. Y.	65
Monsanto Chemical	St. Louis, Mo Avon, Calif.	118
Reichhold Chemicals	Tuscaloosa, Ala	65
Union Carbide	Marietta, Ohio	60
		540
From Cumene		
Allied Chemical & Dye	Frankford, Pa	25
Hercules Powder	Gibbstown, N. J.	26
Standard Oil of Calif.	Richmond, Calif.	35
		86
Byproduct (coal tar and petroleum)		
Koppers, Pittsburgh Consolidated Chemical, Reilly Tar & Chemical, Allied Chemical & Dye, and others.		44
		44
Total		**670**

PHTHALIC CAPACITY: Isomers catch on

Producer	Location	Capacity (Million Lb.)
From Naphthalene (phthalic anhydride only)		
Allied Chemical & Dye	Philadelphia, Pa. Ironton, Ohio Chicago, Ill. Buffalo, N. Y.	145
American Cyanamid	Bridgeville, Pa.	65
Koppers-Pittsburgh	Kobuta, Pa.	15
Monsanto Chemical	St. Louis, Mo Everett, Mass.	75
Pittsburgh Coke & Chemical	Neville Island, Pa.	25
Reichhold Chemicals	Detroit, Mich. Azusa, Calif.	30
Sherwin-Williams	Kensington, Ill.	5
Witco Chemical	Chicago, Ill.	20[2]
		380
From Xylenes (phthalic anhydride and isophthalic acid)		
Amoco Chemicals	Joliet, Ill	60[2,3]
Standard Oil of Calif.	Richmond, Calif.	60[4]
		120
Total		**500**

[1] Both Du Pont and Hercules Powder produce dimethyl terephthalate via the oxidation of p-xylene. In addition, Hercules produces dimethyl isophthalate from m-xylene. [2] Under construction. [3] Includes capacity for benzoic acid and terephthalic acid. [4] Includes 50 million lb. of isophthalic acid.

thesis of chemicals (particularly diisocyanates) have grown.

Actually chemical markets have opened slowly for toluene. Those under active development include a terephthalic acid process which Hercules is reportedly pilot-planting. (This route has a special appeal to a company which, like Hercules, lacks a basic position in aromatics.

Substitution of lower cost toluene for benzene in the production of styrene homologs hasn't been too successful to date, although methyl styrene resins have performed well in some applications.

Toluene is also a starting material for Hercules' route to *p*-cresol—a route similar to its phenol process. But synthetic cresols must compete with coal-tar cresol and refinery-byproduct cresylic acids for main outlets like tricresylphosphate and phenolic resins.

Cresylics from petroleum sources—caustic waste streams from refineries—received a vote of confidence recently in the form of Pittsburgh Consolidation Coal's purchases of crude cresylic acid for processing.

▶ **Wanted: Xylene Isomers** — Xylene's largest use is as a solvent. Mixed xylenes have cut into toluene's solvent market, as have higher-boiling materials of the "Solvesso" type.

Individual isomers of xylene have become important in the synthesis of phthalic anhydride, isophthalic acid and terephthalic acid. Hercules makes iso- and terephthalic from a cut of *m*- and *p*-xylene. Amoco Chemicals is building a plant to use Scientific Design's process for producing all three phthalic acids (or their methyl esters) from a feed of mixed xylenes.

Naphthalene from petroleum —via extraction or synthesis— is not a commercial reality as yet, although Humble Oil and Refining and Standard of Indiana, among others, have done some development work. Thus, phthalic anhydride production is still largely from coal-tar naphthalene.

Increased use in alkyd resins nd plasticizers helped boost phthalic output from 315 million lb. in 1956 to 347 million lb. in 1957.

Convert a gallon of liquid to a powder with 28¢ worth of

MICRO-CEL

SYNTHETIC CALCIUM SILICATES

PROBLEMS IN PROCESS formulatings are finding new answers every day in Micro-Cel . . . Johns-Manville's new line of synthetic calcium silicates.

At a delivered cost of 8¢ to 10¢ per pound Micro-Cel can match—even outperform—many higher-priced fillers in dry or liquid products. Check these three cost-cutting product improvements Micro-Cel can give you.

1. MICRO-CEL remains a free-flowing powder even when mixed with more than twice its weight of liquid . . . provides ultimate absorption of up to six times its weight in water . . . controls viscosity . . . prevents caking.

2. IN DRY PRODUCTS, Micro-Cel will bulk up to a full cubic foot for every six pounds. A little Micro-Cel goes a long way toward improving product density, reducing package outage.

3. MICRO-CEL particles are as small as .02 micron, blend and disperse well, extend pigments to the maximum.

Micro-Cel, the powder that flows like a liquid, is a new line of inert synthetic calcium silicates produced by combining lime with diatomaceous silica under carefully controlled conditions. Its unique combination of properties has already brought important benefits and savings to many processors. *Maybe you will be next.*

For further information, samples and technical assistance write to Johns-Manville, Box 14, New York 16, N. Y. In Canada, Port Credit, Ontario.

You can absorb a gallon of liquid with 3 lb. of MICRO-CEL

and get a dry free-flowing powder like this ➡

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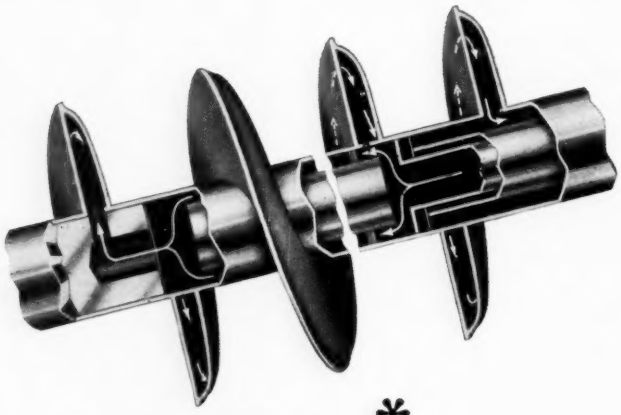
A product of the Celite Division

New savings in heat-exchange processes . . .



THE holo-flite* PROCESSOR
(HOLLOW-FLITE)

A simpler, more compact way to cool, heat or dry—in continuous flow!

Do you have processes where slurries, solids, pulps or pastes must be cooled, heated or dried? Do you know you can now handle such processes—*in continuous flow*—in as little as 1/5th the space required by other types of heat exchangers—and with many other important advantages?

The revolutionary HOLO-FLITE Processor is the answer!

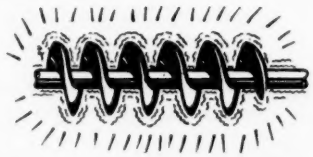
what IT IS!

Basically the HOLO-FLITE consists of two or more flights of hollow-bladed screw conveyors. The product to be processed moves in a trough around the conveyor screws. The heat-transfer fluid circulates through the hollow blades and shafts of the conveyor. The product is constantly rotated into, around, under and over the blades and shafts through which the heat-transfer fluid is circulating, assuring quick, uniform heat passage between the two mediums—*as the product is continuously moved along in a bulk-flow without interruptions!*

Our engineers will gladly study *your particular* operations and make recommendations. Write, wire or phone our nearest office!

why IT'S BETTER!

The HOLO-FLITE principle provides many important advantages in modern processing operations . . .



ITS LARGE HEAT-TRANSFER SURFACE requires far less space—as little as 1/5th the space required by other heat-exchange equipment. Further, flights can be "stacked" as high as desired to save floor space, simplify installation!

ITS SLOW ROTATION IS SO GENTLE that granular and powdered solids are handled with no dusting—little or no particle abrasion. Result—no dust recovery problems . . . simple, inexpensive installation.

IT IS ADAPTABLE to a wide range of applications—handles solids, pulps, pastes and slurries with equal ease. Heat transfer agent can be refrigerant, water or other fluids to provide a wide range of temperatures. Cooled products can be packed directly from HOLO-FLITE discharge, saving time, space and additional handling.

IT CAN BE DESIGNED to handle virtually any capacity by varying the diameter and length of the flights, and the number of "tiers."

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JENKINS FIG. 106-A BRONZE GLOBE 150 LBS. STEAM . . . 300 LBS. O.W.G.

in Disc Equipped Bronze Valves

LOOK **at that Wheel** — Tough malleable iron. Design unequalled for cool, sure grip.

LOOK **at the Index Plate** — Has Fig. No. etched in green background. Held by wheel nut which is secured by rolled-over spindle end.

LOOK **at that Spindle** — Made of high tensile bronze. See how much heavier it is . . . how many more deeply cut threads engage bonnet. And, the crowned head that reduces friction on disc holder. Sure, it costs more to make a spindle this way. But it reduces wear, preserves packing, means easier operation.

LOOK **at the Packing Nut and Gland**—Note the heavy and deep bronze hex. And, that bronze gland designed to compress packing toward spindle.

LOOK **at that Packing Box** — Its depth equals 1½ times spindle diameter. More packing space means less repacking. An asbestos, lubricated and graphited packing is used.

LOOK **at that Bonnet** — One-piece, screw-over design with big hex surfaces is easy to remove. Take an extra look at the bevel joint between bonnet and body, serving as an internal brace against the crushing effect of the bonnet assembly. Millions of Fig. 106-A in use for years prove this unique design licks distortion and springing.

LOOK **at the Disc Holder** — It's the Slip-on Stay-on type originated by Jenkins. Correct protective depth prevents flaking or cracking of disc.

LOOK **at the Disc** — Easily renewed without removing valve from line. Made of compositions to suit various services . . . and **made by Jenkins**, the only maker of both valves and discs.

LOOK **at that Body** — Just compare wall thickness of this high tensile bronze body with any other valve. The factor of safety is many times higher than rating requires. See the curved diaphragm to protect seat from distortion by pipe strain. Note that the raised seat is higher to permit more reseating operations . . . and wider, so it won't cut into disc. Pipe threads are full length and clean cut.

LOOK **at this . . . for Throttling**

—Just replace the standard disc nut with this Throttling Nut and a Fig. 106-A becomes well-suited to throttling service. This unique nut reduces the effects of wire drawing and its long legs restrict flow for accurate control. Many plants take advantage of this versatile valve to reduce valve and parts inventory.

THE FIRST renewable composition disc valve was a Jenkins Valve, originated nearly a century ago. Compare today's Fig. 106-A Bronze Globe with any other. See why so many valve users agree that a *Jenkins* is still the FIRST for top value. For descriptive folder No. 189-B on the full line of Jenkins Bronze Globe, Angle and Check Valves write to Jenkins Bros., 100 Park Avenue, New York 17.

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LOOK FOR THE JENKINS DIAMOND
VALVES

SOLD THROUGH LEADING DISTRIBUTORS EVERYWHERE

THIS IS BAILEY ARMORTUBE CABLE

every foot you install saves you $5 to $6

ARMORTUBE Cable consists of multiple copper or aluminum tubes in a single, flexible armored cable. You string *one* line. You buy *one* set of standard pipe supports or conduit clips. You make a neater, protected installation. Installation costs are reduced tremendously.

Users of copper or aluminum tubing for connecting pneumatic instrument and control lines report that it costs about $2.00 a foot to install single tubes.

It costs the same $2.00 a foot to install Bailey ARMORTUBE Cable.

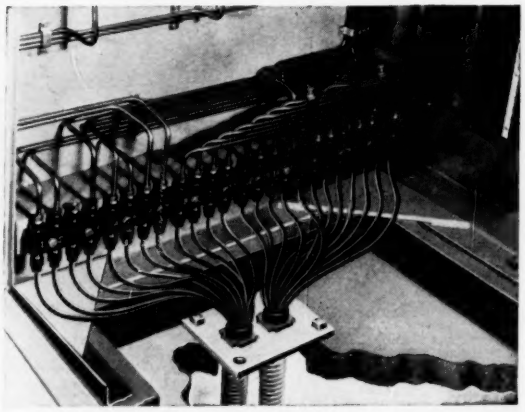
But here's what customers tell us . . .

SAVES $3,000—A chemical plant bought 530 feet of 4-tube Bailey ARMORTUBE Cable and installed it at a saving of $3,000 over the cost of four single tubes.

SAVES $14,000—Another chemical plant bought ARMORTUBE Cable costing $1,345. The saving on installation compared to single tubes amounted to $14,000.

SAVES $60,000—An electric utility bought $14,068 worth of ARMORTUBE Cable . . . saved $60,000 on installation.

Whether your next job consists of 100 or 100,000 feet of tubing, it will surely pay you to check on savings possible with Bailey ARMORTUBE Cable. For more information ask for Product Specification and Price List G91-9.



NOW—to meet increasing demands, this cost-saving product is offered in a full family of sizes and types. In the quarter-inch tube size, ARMORTUBE is available in both copper and aluminum with 2, 3, 4, 5, 7, 8, 10, 12 or 19 tubes. Tubes are protected with galvanized steel armor or a combination of steel armor and thermoplastic . . . with thermoplastic sheath located either over or under the steel. Other sizes are copper tubes in steel armor only: ⅜" in bundles of 1, 2, 3, 4, 7; ½" in bundles of 1, 2, 3, 4. G-38

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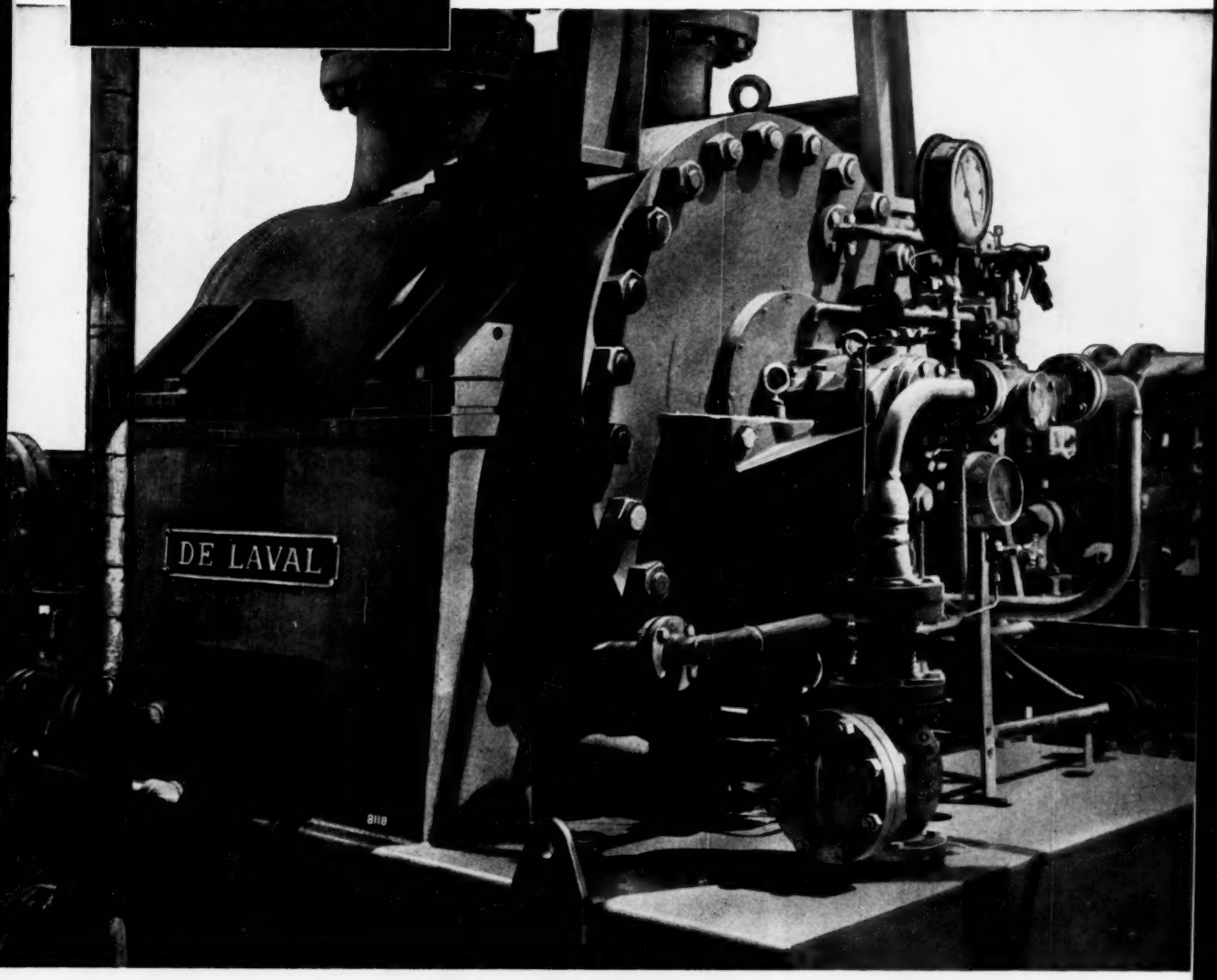
DE LAVAL
BARREL TYPE REFINERY COMPRESSOR

handles hydrogen under high pressures in a reformer at General Petroleum



Send for new Bulletin 0504

This De Laval centrifugal recycle barrel type compressor is doing a dependable job handling hydrogen under high pressures at the General Petroleum plant in Ferndale, Washington. It takes hydrogen at an inlet pressure of 500 psig and discharges it at 625 psig. The unit is driven by a 1110 hp turbine operating at 9900 rpm.

General Petroleum Corporation is only one of many refiners who have specified De Laval Compressors. Whether you need to handle light or heavy gases at high or low pressures in catalytic cracking, reforming, alkylation, coking or any similar service, it pays to look to De Laval. Rugged De Laval centrifugal compressors perform dependably in heavy-duty continuous operation. De Laval has more than 40 years of experience in solving gas compression problems.

DE LAVAL *Centrifugal Compressors*

DE LAVAL STEAM TURBINE COMPANY
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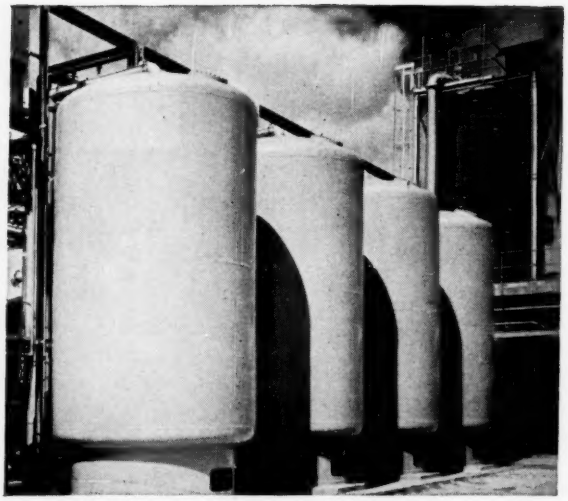
ENGINEERING. Permutit engineers work with your staff or your consulting engineers to design all or any part of your water conditioning system.



EQUIPMENT. Permutit supplies complete equipment. Critical parts such as valves, chemical feeders and controls are designed and made by Permutit.

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U. S. industry is faced with using lower grade water. Results: possible boiler scale, turbine deposits, corrosion of pumps and piping . . . also stains, blisters and other problems in plating, rinsing, dyeing and chemical processing.

• **For expert answers,** more and more management men and their consultants are buying the complete service offered by leading water-conditioning firms. Here's how Permutit (rhymes with "compute it"), a pioneer and largest in the field, tackles a water problem:

• **Water analysis,** study of the problem and past experience provide data on possible methods of treatment. The process offering the best balance of initial and operating cost vs desired quality of treated water is selected.

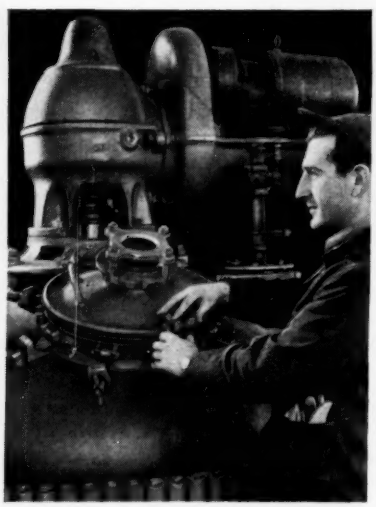
• **Complete proposal** by Permutit engineers covers type, size and capacity of equipment, price, any special engineering services and guarantees.

• **Manufacturing**—After the proposal is accepted, Permutit designs the entire project, schedules assembly and shipping. Critical parts, ion exchange resins, control panels are all made in Permutit plants. (No other U. S. firm makes all these components.)

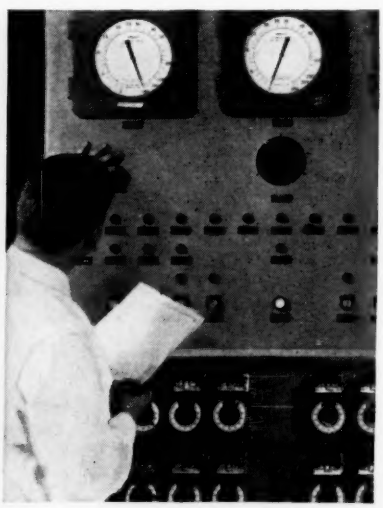
• **Test runs**—Where required, Permutit checks the installation, supervises start-up and initial operation, trains permanent operating personnel.

• **For further information** look up the Permutit office in your city or write to The Permutit Company, a division of Pfaudler Permutit Inc., Dept. CE-5, 50 West 44th St., New York 36, N. Y.

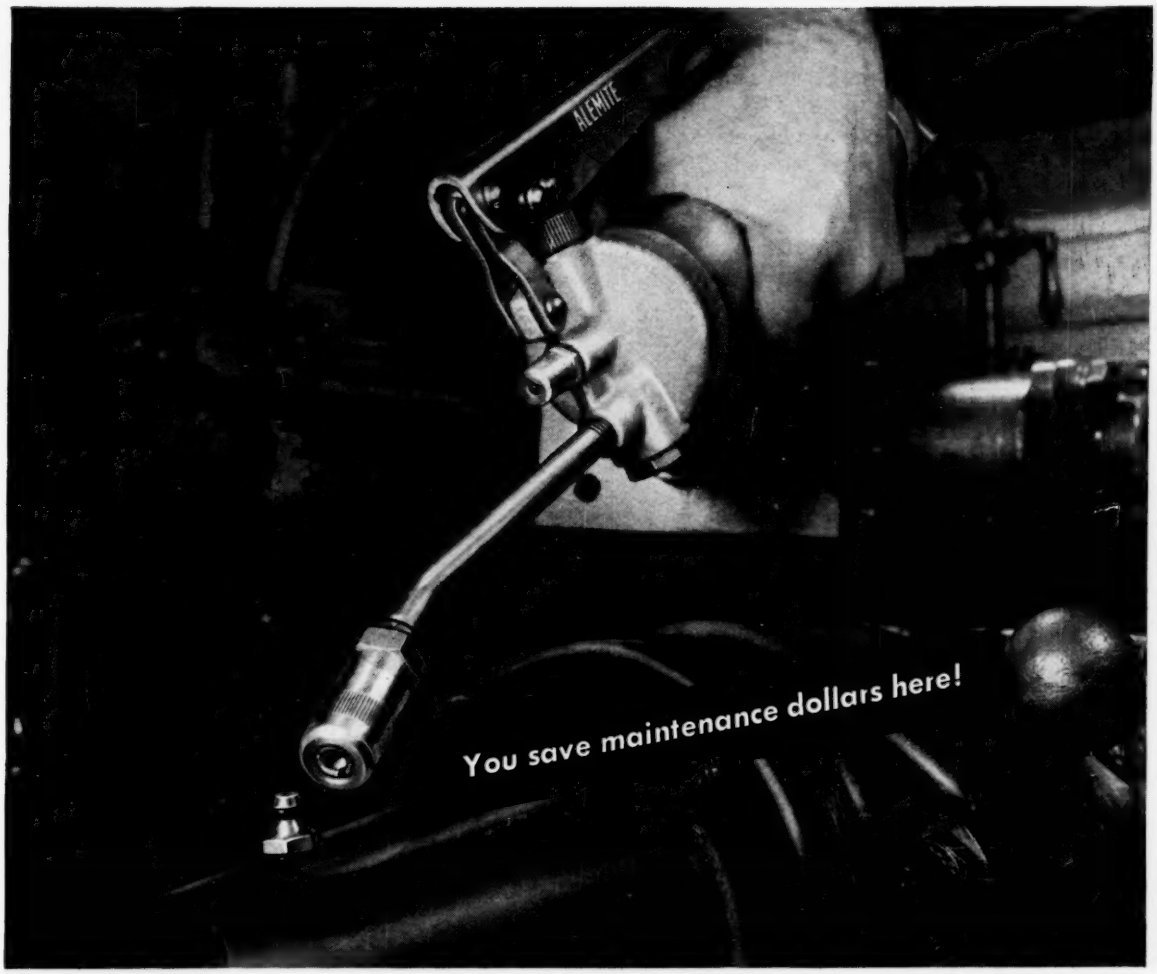
WATER ANALYSIS. Permutit's modern water-analysis laboratory tests over 1200 samples a month!



ION EXCHANGE RESINS. Permutit makes its own ion exchange resins, natural and synthetic zeolites.



AUTOMATIC CONTROLS to ensure optimum results are designed, assembled, wired and tested by Permutit.



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The point of lubrication is where maintenance costs can be cut—providing you have the right equipment for the job!

This heavy-duty Alemite hand gun—combined with genuine Alemite lubrication fittings—brings up to 10,000 lbs. of pressure to even ordinary lubrication points. It gives you power to spare for fast, efficient, money-saving protection of every machine in your plant!

Gun handles all regular pressure gun greases. Long operating handle for maximum leverage. Loader fitting permits fast, clean filling (or gun may be filled by suction). Heavy steel linkage for true piston alignment. Capacity, 1 lb. Get more out of man-hours and machine-hours with Alemite lubrication equipment!

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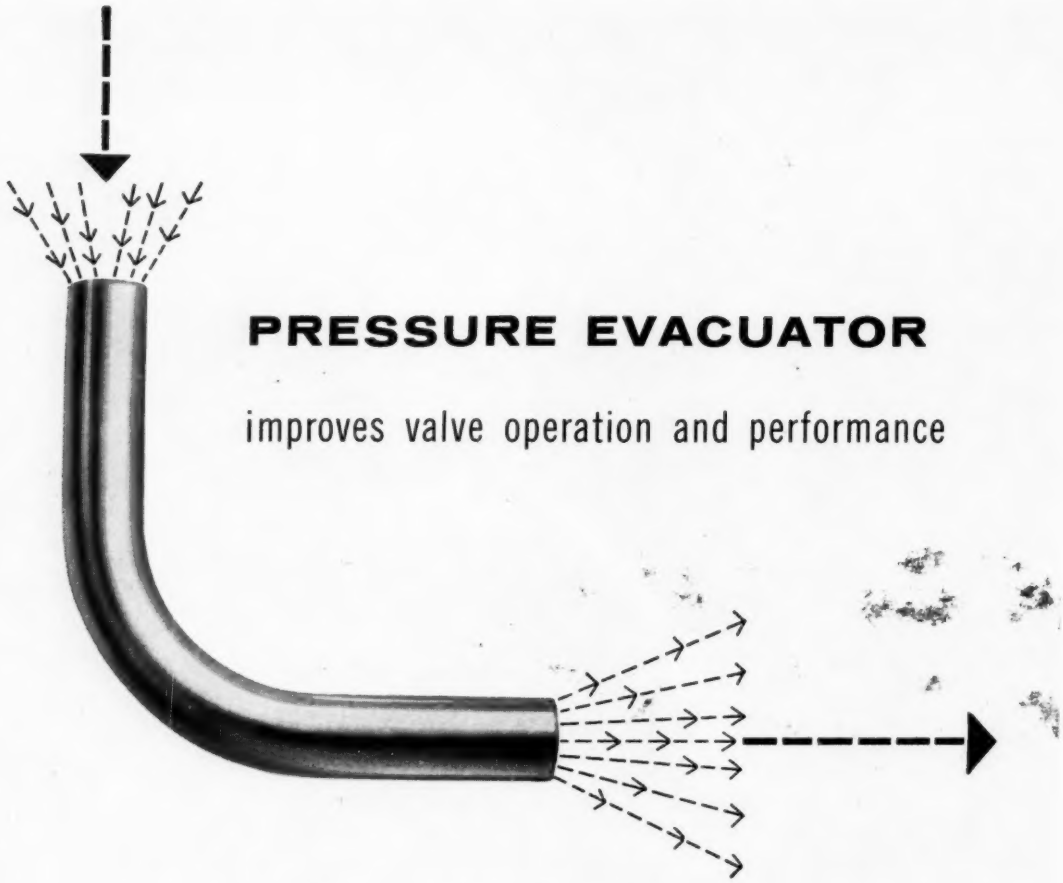
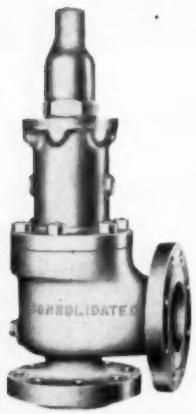


PRESSURE EVACUATOR

improves valve operation and performance



Consolidated Safety Relief Valve, Type 1900 Series, Sizes: 1" x 2" to 8" x 10".

The Eductor Tube in Standard Consolidated Safety Relief Valves is a pressure evacuator. It efficiently removes pressure from the closed bonnet. If allowed to remain in the bonnet, the pressure would act on the top of the disc and tend to limit the lift and induce cycling. But with the pressure evacuated from the closed bonnet through the Eductor Tube, the spring alone controls valve action. Consequently, *reliable* valve action and guaranteed capacity ratings are attained. A new high in operational dependability is assured.

Reliable operation and performance of Consolidated Safety Relief Valves are your assurance of absolute protection for personnel and equipment. "2 in 1" design permits you to convert the Standard valve to the Bellows type in your own shop. But that is only part of the total economy of these modern valves. Get the complete inside story. Write for Catalog 1900.

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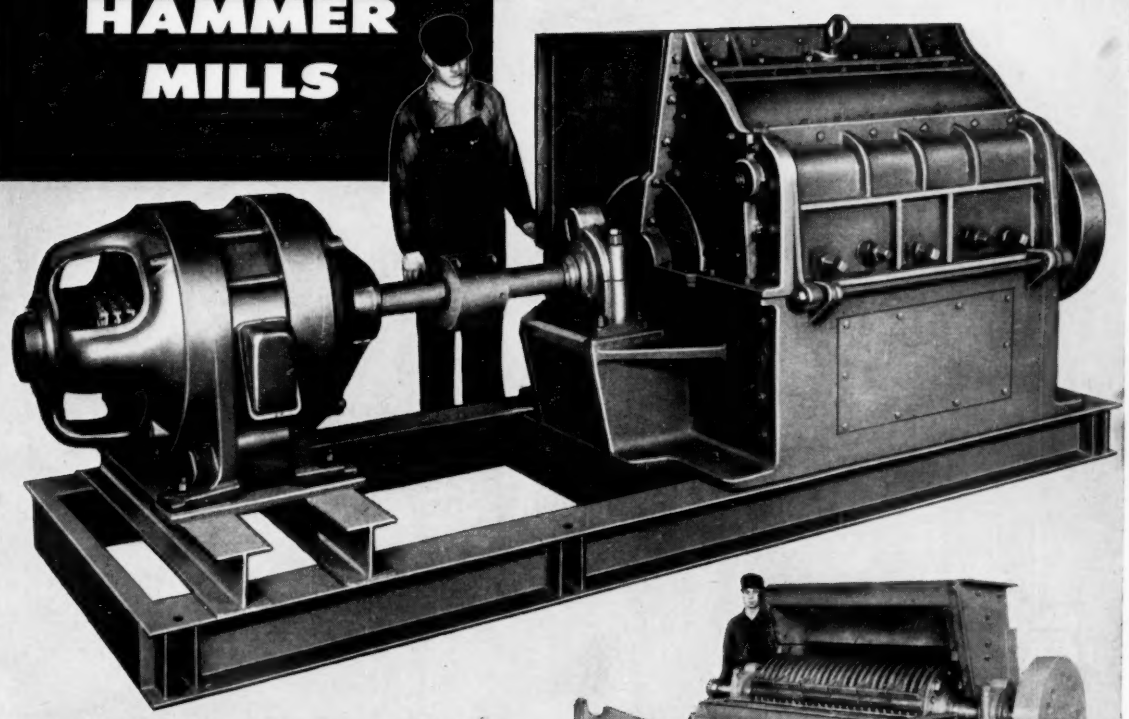
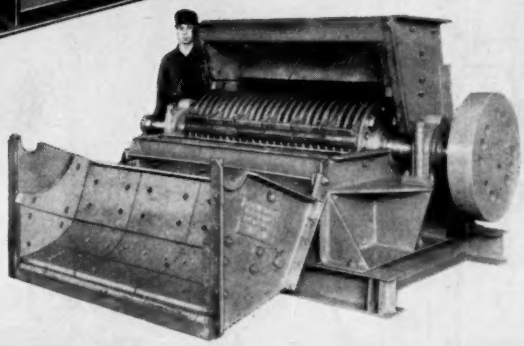
WILLIAMS *heavy duty* HAMMER MILLS





- **Crushes, Grinds, Shreds To Finished Size In One Operation**
- **Reduces Production Costs Up To 50%**
- **Saves Up To 75% On Equipment Cost**

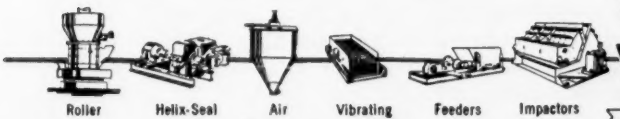
Williams No. 60 GA Mill with heavy duty steel plate frame. Cover has been opened to show heavy duty manganese steel liners, breaker plates, grate bars and hammers.

Whether your size reduction job involves crushing, grinding or shredding—whether the material is mineral, chemical, vegetable or animal—Williams has a hammer mill designed to *do it from start to finish in a single operation.* More uniform product, increased output, plus savings in time and labor can *cut production costs as much as half!*

Extra primary and secondary crushers are seldom required with a Williams—no extra drives or conveyors, no costly foundations or buildings for additional crushers are necessary. Expensive maintenance, replacement parts, excessive downtime and labor are reduced to a minimum.

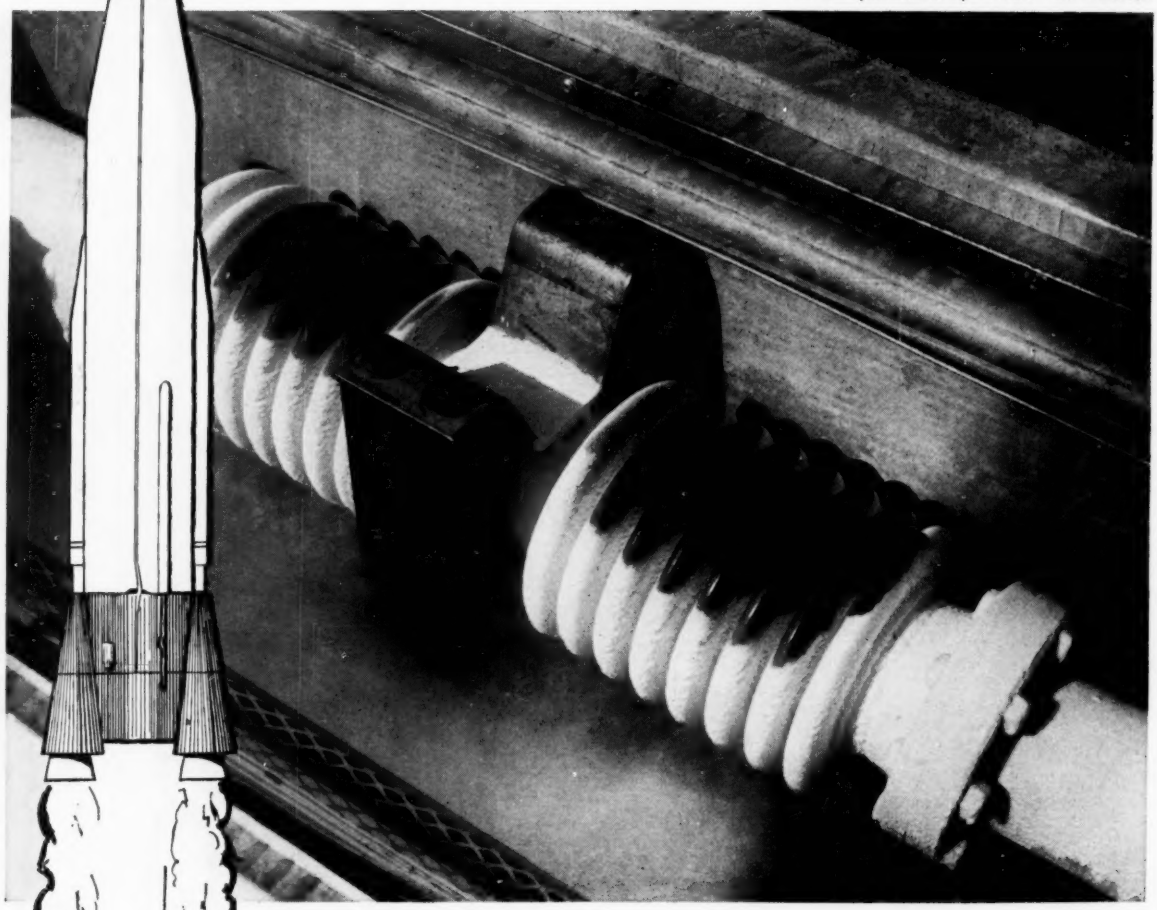
Learn how a Williams hammer mill can step up your output, and improve your product quality. *Write —explain your operation—and ask for a catalog.*

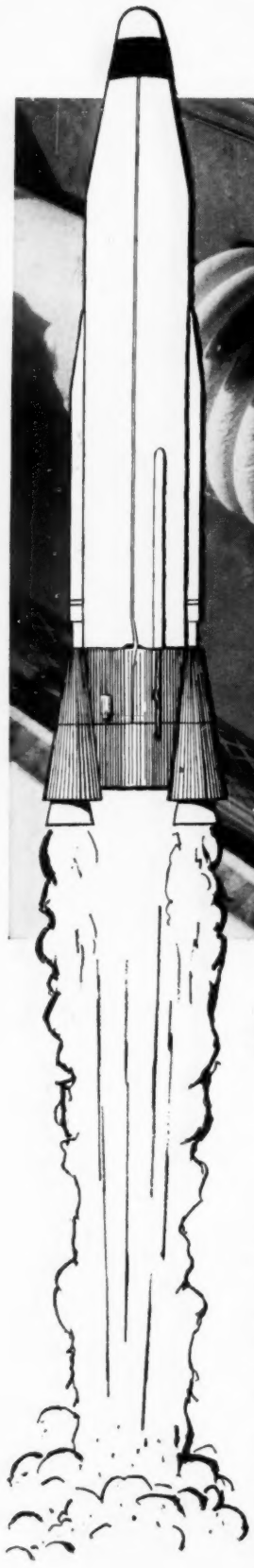
WILLIAMS PATENT CRUSHER & PULVERIZER CO.
2706 N. 9th St. St. Louis 6, Mo.



WILLIAMS
CRUSHERS GRINDERS SHREDDERS
Oldest and Largest Manufacturers of Hammer Mills in the World

For temperatures of –300F and below!





Sola-Flex® joints provide safe, easy handling of liquid missile fuels

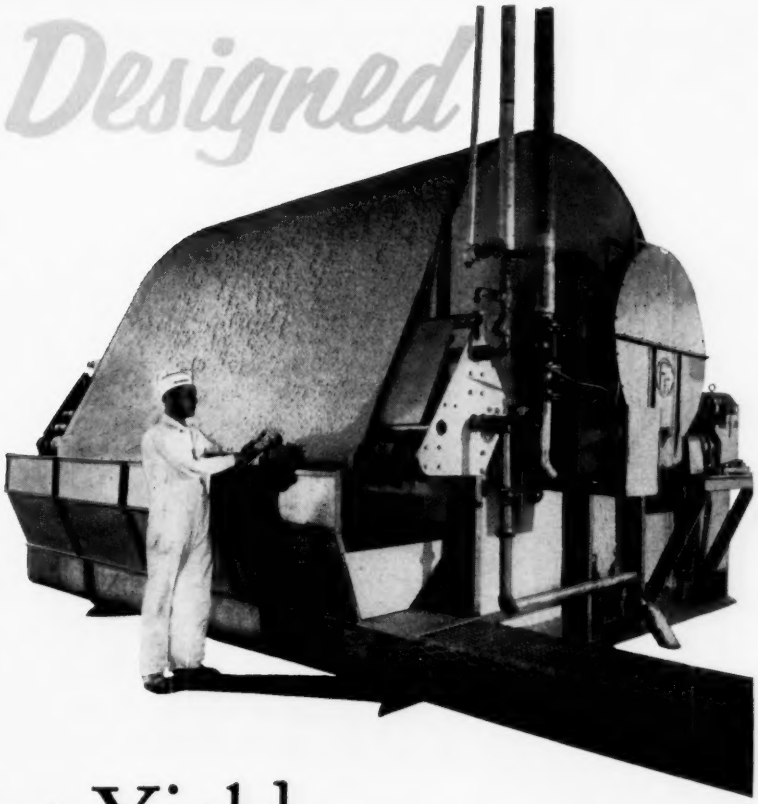
LIQUID OXYGEN, used in Convair's *Atlas* ICBM, requires the very best handling know-how—and equipment. These rugged Sola-Flex expansion joints are in use on Convair's fuel test facility at San Diego, California. Made from 321 stainless, the 6 in. double-end anchor-base unit handles over 5 in. of axial movement in a LOX test line.

Solar manufactures the most comprehensive line of bellows and expansion joints in the world. They are made from a wide variety of stainless and high alloys for important nuclear, missile and industrial applications—in sizes ranging from ½ in. to 35 ft in diameter. They are built for service from –320F to 1200F. And they tame "hard-to-handle" pressures up to 3500 psi for special applications.

A new pamphlet describes Solar's complete line of expansion joints. Write for it to Dept. F-15, Solar Aircraft Company, San Diego 12, California.

SOLAR AIRCRAFT COMPANY — SAN DIEGO, DES MOINES

Custom Designed



For a Bigger Yield

Higher yield in your case may mean cleaner, dryer cake . . . or better recovery of solubles . . . or just plain fast, trouble-free operation on a job that's got to be done. If you can get a few points better efficiency at no extra cost, why not?

FEinc custom-designed continuous vacuum filters have been doing just this for 37 years: For instance:

- Replaced six settling tanks in recovering plastic grinding waste . . . paid for itself in 3 months
- Reduced moisture in iron pigment from 68 to 59%
- Cut recycling of difficult gelatinous sulphate cake from nine to five cycles
- Eliminated plugging, gave three hours more running time daily on sticky clay
- Reduced solubles in metallic stearate from 0.5 to 0.05%
- Recovered ⅔ of chromates left by competitive filter

All types of continuous rotary vacuum filters . . . string, horizontal, scraper, precoat, etc. . . . are custom designed and manufactured by FEinc . . . quality built because quality pays you. Ask for bulletins . . . or for recommendations . . . no obligation, of course.

47 *See our insert in Chemical Engineering Catalog or write today*

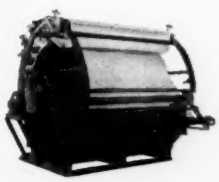
For a Bigger Yield

FE INC®

FILTRATION ENGINEERS

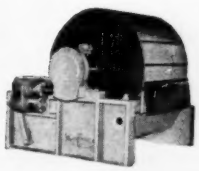
AMERICAN MACHINE AND METALS, INC.

EAST MOLINE, ILLINOIS



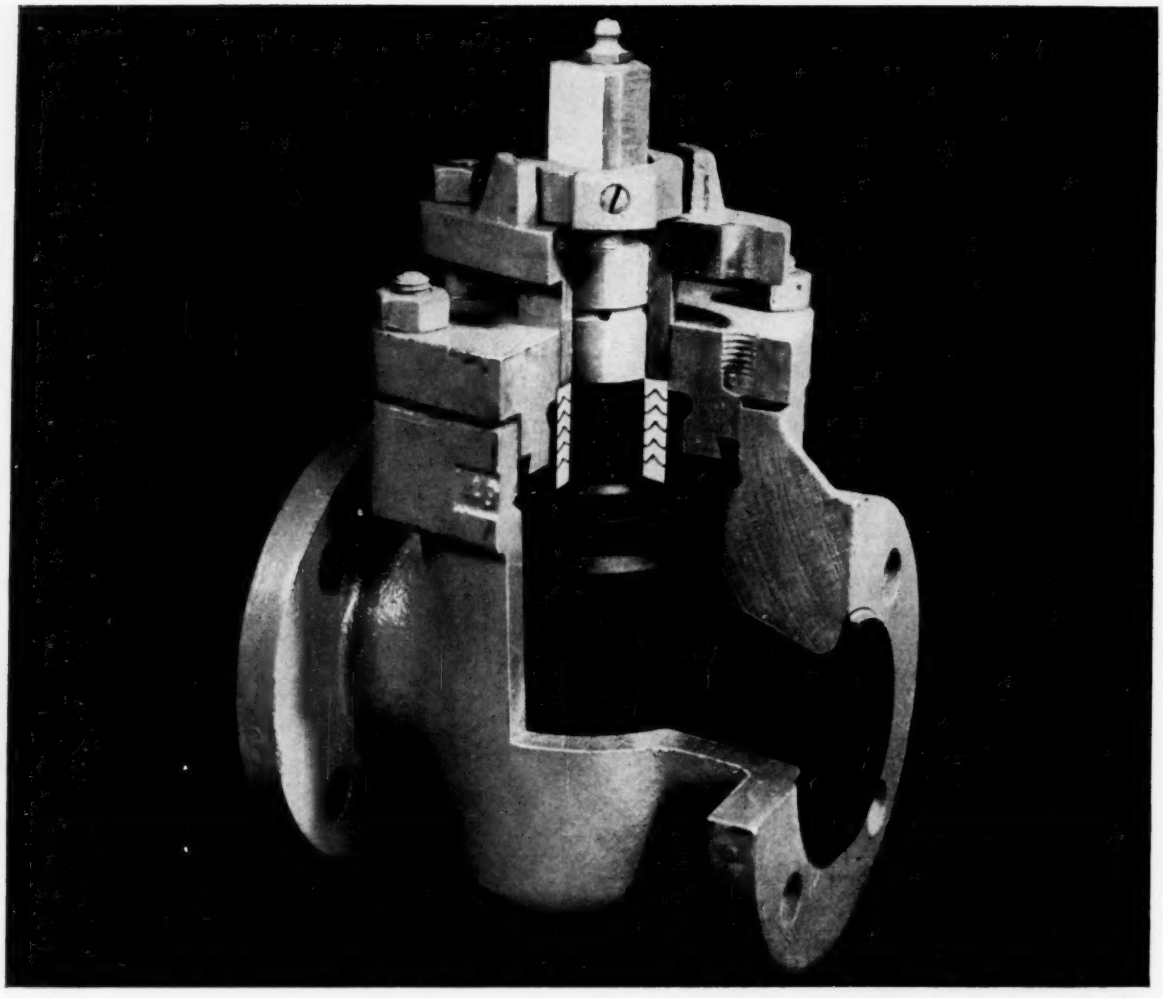
STRING

HORIZONTAL



SCRAPER

CUSTOM DESIGNED CONTINUOUS FILTRATION



You can see why Saran Lined Pipe costs so little per year of service

Saran anchored within a steel casing safely conveys corrosive liquids for years of trouble-free service

There's something special about this valve. It's saran lined and has a Teflon V-ring packing for easier opening and closing and more perfect sealing with less pressure. And yet, the fact that valves like this are stock items is another example of why saran lined piping systems are more economical to install.

Immediate availability of Saran Lined Pipe, valves, pumps and fittings means there's no waiting. And Saran Lined Pipe can be cut and threaded right on the job with conventional tools. This lower fabrication cost, combined with the long life of corrosion-resistant saran, means that complete saran lined piping systems cost less in the long run.

Saran Lined Pipe with the new gray liner gives trouble-free service under operating pressures from full vacuum up to 300 psi and temperatures from -20° F. up to 200° F.

Send the coupon today to learn how you can save by installing a complete corrosion-free piping system with Saran Lined Pipe, valves, pumps and fittings. And be sure to ask about Saraloy® 898 tank linings. THE DOW CHEMICAL COMPANY, Midland, Michigan.

SARAN LINED PIPE COMPANY
DEPT. 2003 A
2415 BURDETTE AVENUE
FERNDALE 20, MICHIGAN

Please send me information on: ☐ Saran Lined Pipe, fittings and valves ☐ Saran lined centrifugal pumps ☐ Saraloy 898 chemical-resistant sheeting

Name_____ Title_____ Company_____

Address_____ City_____ State_____

YOU CAN DEPEND ON DOW

Why bother with unreliable water supplies?

Get fresh water from the sea...trouble-free ...with Cleaver-Brooks Flash Evaporators

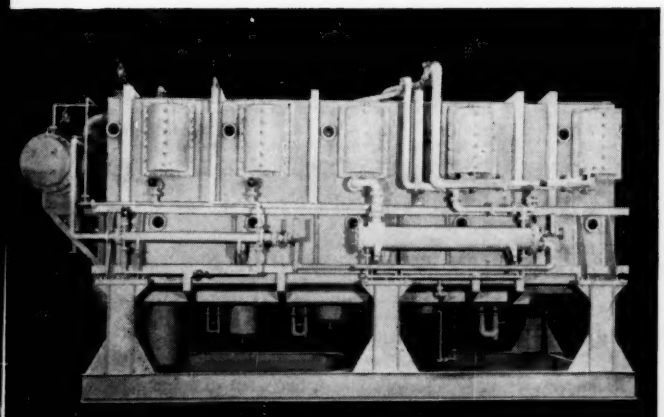
Where sea water is the only source of water, Cleaver-Brooks Flash Evaporators are the economical and dependable answer to fresh water problems. Cleaver-Brooks units produce volumes of pure, fresh water from the sea . . . 24 hours a day, month after month . . . no worries about delivery schedules or pipe line failures.

Cleaver-Brooks Flash Evaporators' dependable performance is made possible by an advanced engineering principle . . . flash evaporators literally flash water into steam. No boiling on heat transfer surfaces, no scale or sludge cleaning problems. The result: Low maintenance costs, little downtime. Automatic principles give you further savings on operating costs.

Whatever your fresh water needs, 10,000 gallons per day, 500,000 gallons or more, it will pay you to investigate Cleaver-Brooks Flash Evaporators.

Trouble-free Cleaver-Brooks Flash Evaporators produce pure water more economically than you ever thought possible.

For more information and specifications write to Cleaver-Brooks Company, Special Products Division, 225 Grand Ave., Waukesha, Wisconsin, Dept. CE58.



Cleaver-Brooks Flash Evaporators such as the one pictured here will soon be in service in two South American communities, each supplying 50,000 gallons of water per day. Thousands of other Cleaver-Brooks evaporators have been and are producing fresh water in 22 other countries . . . all over the world.

Cleaver Brooks®

BUILDERS OF EQUIPMENT FOR THE GENERATION AND UTILIZATION OF HEAT

long-run power by Allis-Chalmers

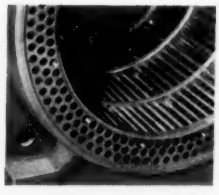
NOW... tube-type MOTORS with capsule-mounted split-sleeve bearings

Now the most effective air cooling system ever designed for larger TEFC motors has been combined with the accessibility of capsule-mounted split-sleeve bearings. *Both* of these user benefits are available in a newly designed line of Allis-Chalmers tube-type motors.

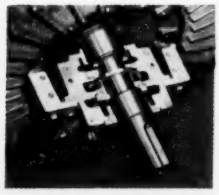
Indoors or outdoors, these Allis-Chalmers motors are ideal for moist, corrosive and hazardous atmospheres. Contact your A-C district office, or write Allis-Chalmers, General Products Division, Milwaukee 1, Wisconsin.

ALLIS-CHALMERS

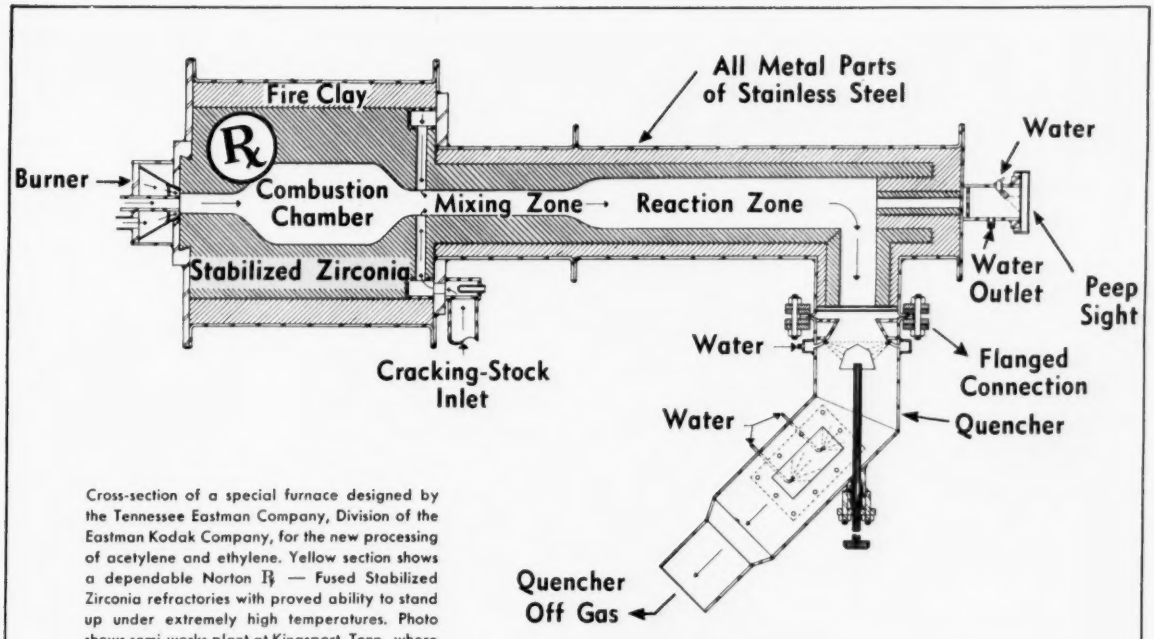
A-5580



Cooling system works like this: Air circulated within the motor by internal fans transfers motor heat to a nest of tubes around the stator. External fans constantly blow cool air through the tubes to absorb and remove heat.



Capsule mountings permit access to bearings without exposing vital electrical parts. This design is available for directly coupled drives; ball or roller bearings also available.



Cross-section of a special furnace designed by the Tennessee Eastman Company, Division of the Eastman Kodak Company, for the new processing of acetylene and ethylene. Yellow section shows a dependable Norton Rx — Fused Stabilized Zirconia refractories with proved ability to stand up under extremely high temperatures. Photo shows semi-works plant at Kingsport, Tenn., where a year of experimental furnace operation produced 1,000,000 lbs. of acetylene and ethylene — an excellent background for increased commercial production.

New Tennessee Eastman Process uses NORTON Zirconia Refractories

Zirconia lining permits high, uniform heat flux for improved production of acetylene and ethylene.

Heart of Tennessee Eastman Company's advancement in processing acetylene and ethylene is a newly designed furnace. Here, saturated hydrocarbons are decomposed in hot combustion gases. High temperature heat must be supplied rapidly and uniformly. Since an endothermic reaction is involved, a zirconia lining was specified because of its ability to insulate at high temperatures and to conserve valuable heat. This furnace operation required refractories capable of withstanding continuous operation at temperatures in excess of 2,000°C.

Norton Fused Stabilized Zirconia was specified in special shapes for the inner courses of the combustion chamber, mixing zone and reaction zone. As a result, the structural stability and suitability of the furnace for continuous use was confirmed when the combustion chamber was found to be in excellent condition after 100 days of operation.

The development of Fused Stabilized Zirconia is a typical Norton aid in utilizing higher temperatures for greater efficiency and output. Norton was first to bring this valuable material out of the experimental stage. Now it is used in many forms for commercial production.

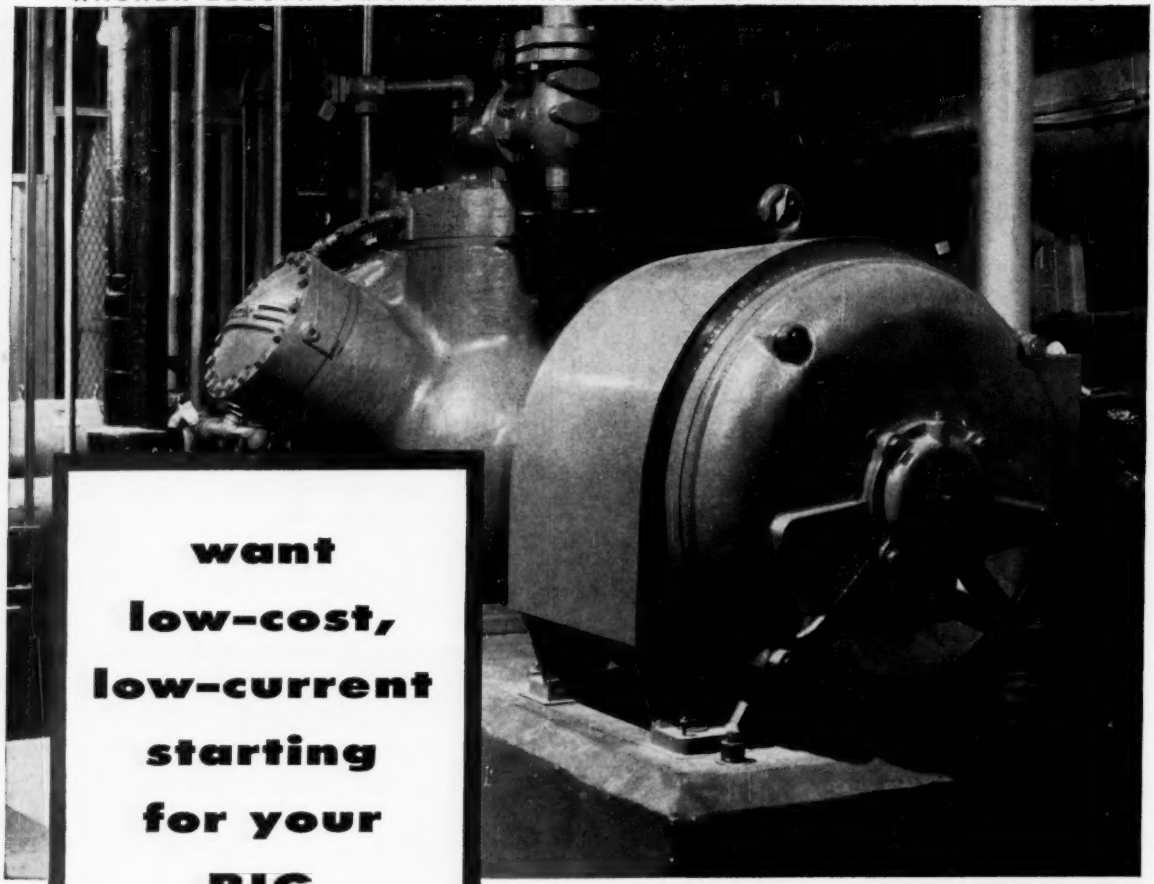
Investigate Norton Rx's — refractories *engineered and prescribed* to save time, work and money. See your Norton Representative or write to NORTON COMPANY, Refractories Division, 504 New Bond St., Worcester 6, Massachusetts.

NORTON
REFRACTORIES
Engineered... Rx ...Prescribed

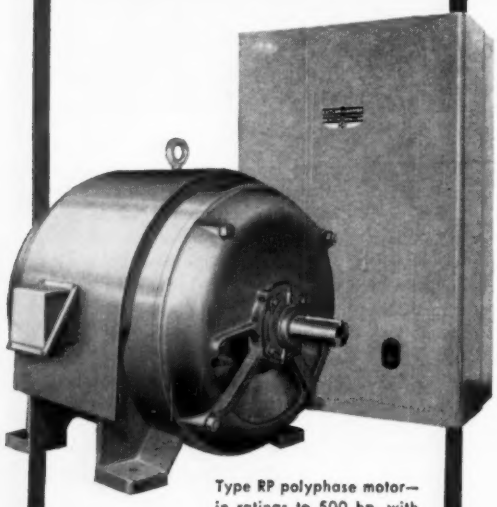
Making better products . . . to make your products better

NORTON PRODUCTS Abrasives • Grinding Wheels • Grinding Machines • Refractories • Electrochemicals — **BEHR-MANNING DIVISION** Coated Abrasives • Sharpening Stones • Pressure-Sensitive Tapes

WAGNER ELECTRIC MOTORS...THE CHOICE OF LEADERS IN INDUSTRY



want low-cost, low-current starting for your BIG MOTORS?



Type RP polyphase motor—in ratings to 500 hp. with increment type starter.

WM58-1

Specify Wagner Increment Motor-Starter Combinations

Part-winding starting is the simple, inexpensive way to limit the inrush of starting current in squirrel-cage motors up to 500 horsepower—and only the Wagner Increment Motor-Starter Combination gives you all these advantages:

LOW FIRST COST—Uses a standard Wagner Motor and a part-winding starter—no need for auto-transformers or resistors.

EASE OF INSTALLATION—Starter is compact and relatively light in weight, connections are simple and easy to make.

MINIMUM MAINTENANCE—The Wagner Motor requires only regular inspection, cleaning and lubrication—the starter needs very little attention.

APPROVED BY POWER COMPANIES—Meets all polyphase motor starting requirements of AEIC—EEI—NEMA—reduces voltage fluctuations—does not open the line during the starting period.

PROVED IN SERVICE—Wagner pioneered this Motor-Starter Combination—has been furnishing it for more than 18 years—its steadily increasing popularity is proof of its efficiency and dependability.

Why not take a look at Wagner Increment Motor-Starter Combination in operation? Ask your nearby Wagner Sales Engineer to show you an installation in your area. See how it works—judge for yourself, and let him help you select the combination that meets your requirements. Just call the nearest of our 32 branch offices, or write for Bulletins MU-128 and MU-195.

Wagner Electric Corporation
6407 Plymouth Ave., St. Louis 14, Mo., U.S.A.

BRANCHES AND DISTRIBUTORS IN ALL PRINCIPAL CITIES

ELECTRIC MOTORS • TRANSFORMERS • INDUSTRIAL BRAKES • AUTOMOTIVE BRAKE SYSTEMS—AIR AND HYDRAULIC

to move bulk materials with an *Airstream* Conveyor

Sleek, slim pipelines typify streamlined bulk handling with Dracco Airstream Conveyors. From intake point to destination, pipelines are all that can be seen. They run on or just underneath the roof . . . underground . . . up the sides of buildings . . . between or through walls . . . around corners.

If you're planning on modernizing your plant, take a step in the right direction by modernizing bulk handling first. You can create breathing space for new equipment by replacing cumbersome mechanical conveyors with a space-saving Airstream system. Pipelines easily adapt to new or existing plant layout. Costs shrink, too, as manual handling is eliminated, labor and maintenance expenses minimized.

At the intake point, a hopper or nozzle receives materials from boxcars, hopper cars, trucks, barges, bags or storage bins. Part-time supervision of one man is usually all that's needed. Air does the handling, moving materials swiftly and without dust, waste or contamination to storage bins or process.

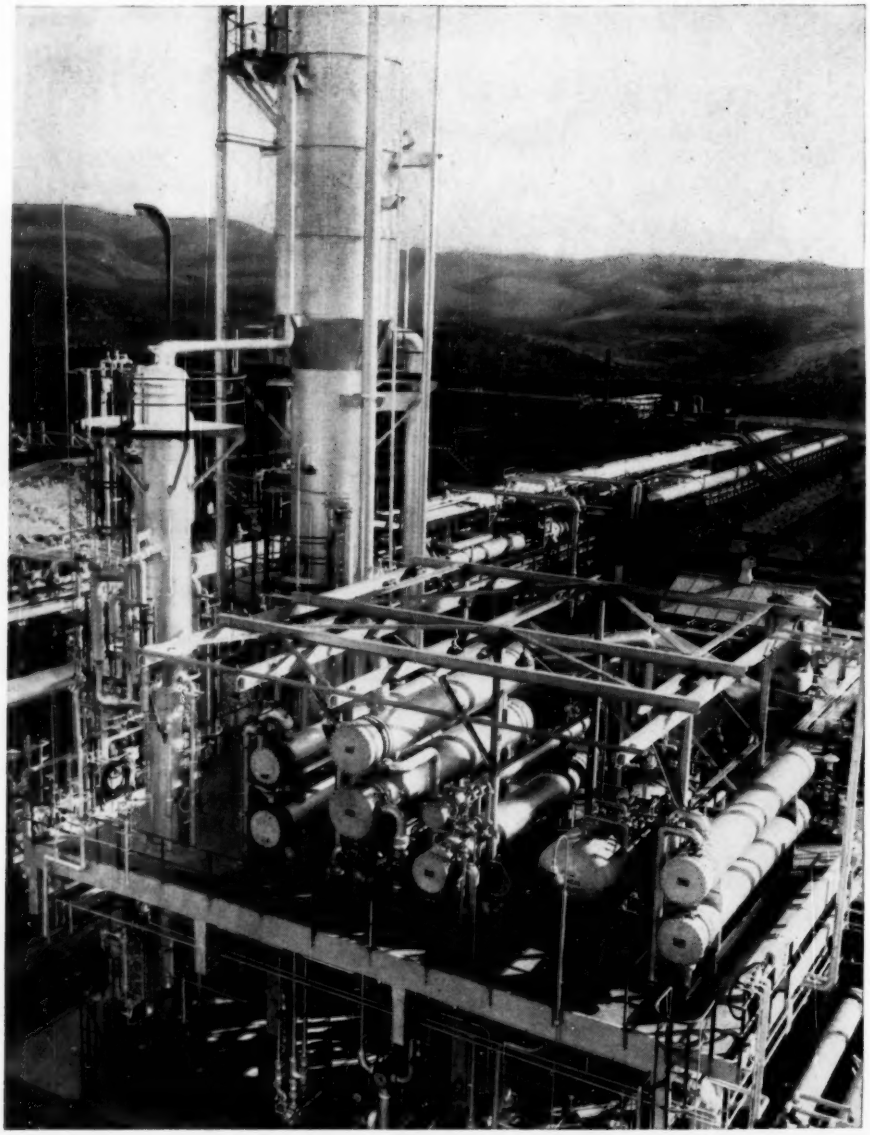
Engineers from Dracco will be glad to discuss materials handling problems with you at your convenience. For more information, call or write today.

DRACCO DIVISION OF FULLER CO.

4040 East 116th Street • Cleveland 5, Ohio

New 32-page brochure presents detailed information on how Dracco Airstream Conveyors have solved bulk materials handling problems. Write for Bulletin 530.

DRACCO *airstream* conveyors
dust control equipment



Oleum Refinery, Union Oil Company, California. Large topping column is of stainless steel with stainless trays and caps. Smaller stripping column and heat exchangers are of carbon steel. Diameters of exchangers range up to 36".

ON

STREAM

AT

UNION

OIL

YUBA ENGINEERED EQUIPMENT

What Yuba has done for Union Oil it can do for you... design and manufacture a *SINGLE UNIT* or equip an *ENTIRE SECTION* of a processing plant.

Yuba is geared to furnish heat exchangers, columns, towers, storage tanks, pressure vessels, expansion joints, and structural fabrication.

In the design of Yuba equipment many unique features have been incorporated. For example, Yuba heat exchangers for high temperatures and pressures feature the famous Multilok closure and welded tubes.

Plants conveniently located in East and West. May we have your inquiry?

YUBA CONSOLIDATED INDUSTRIES, INC.

351 CALIFORNIA STREET, SAN FRANCISCO 4, CALIFORNIA

Divisions Manufacturing Heat Exchangers

YUBA HEAT TRANSFER DIVISION
Honesdale, Pennsylvania

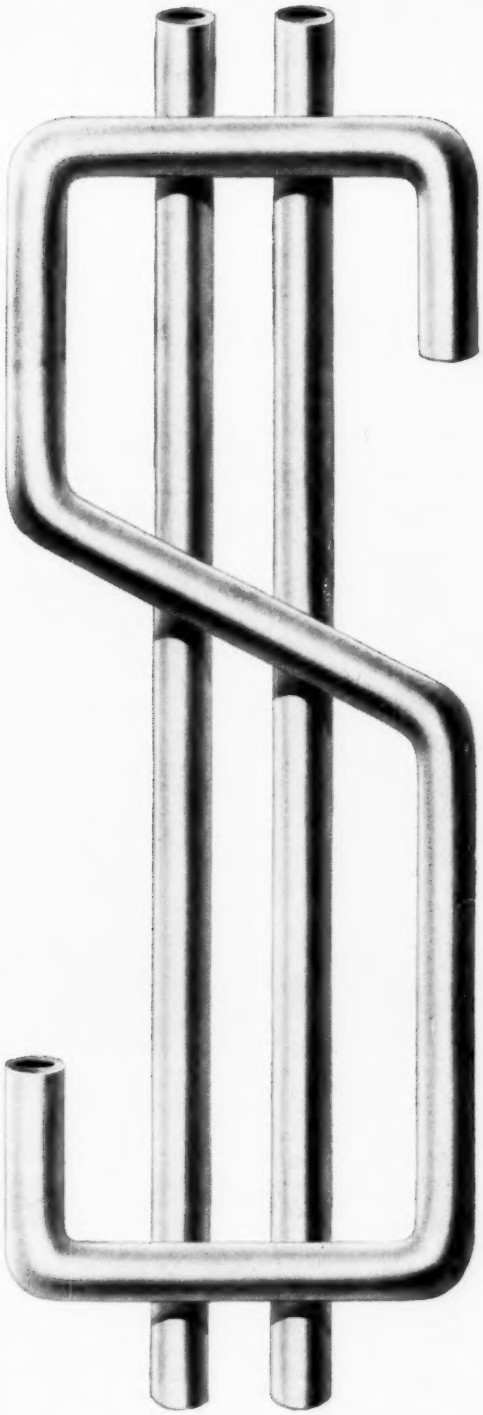
YUBA MANUFACTURING DIVISION
Benicia, California

YUBA

San Francisco Sales Office:
520 Balfour Building

New York Sales Office:
530 Fifth Avenue

Sales Offices and Representatives in Principal Cities



Turn your pressure tube problems into savings

Timken Company metallurgists can select the <u>one</u> steel analysis that gives you maximum tube life-per-dollar

A lot of steels can solve the pressure, temperature and corrosion problem that your particular operation creates. But it takes skill to find the one and only steel analysis that gives you longest tube life for your dollar.

Timken Company metallurgists have the special skill to save you money while solving your pressure tube problem. They're recognized experts backed up by more than 25 years of research and experience in high temperature steels. They've solved hundreds of industry's toughest pressure problems the same way they'll solve yours—economically.

And they've got the steels at their fingertips. You can get Timken® seamless pressure tubes in sizes up to 11″ O.D. x 3¼″ wall—available in all stainless and alloy grades.

One analysis of Timken fine alloy steel will meet your operating conditions best. And you can be sure it's an accurate analysis because we make only electric furnace fine alloy steel and use rigid quality controls to give uniformity from heat to heat, order to order, tube to tube.

Get in touch with Timken Company metallurgists next time you have a pressure problem. They'll solve it the only way they know—economically. The Timken Roller Bearing Company, Steel and Tube Division, Canton 6, Ohio. Cable address: "TIMROSCO".

TIMKEN *Fine Alloy* **STEEL**

TRADE-MARK REG. U.S. PAT. OFF.

SPECIALISTS IN FINE ALLOY STEELS, GRAPHITIC TOOL STEELS AND SEAMLESS STEEL TUBING

UNICHROME
Trade Mark

News about
COATINGS for METALS
Metallic.....Organic.....Decorative.....Protective

Plastisol coating seals out corrosion

Tank lining has built-in visual cure control

One of a group of Unichrome drum and tank lining materials, Coating B-124 is an unusual phenolic type material. When wet, it is gray in color. When fully cured, it is olive drab. This color change gives visual security against "half-baked" protection especially in large tanks and tank cars where heat application may be uneven.

Also in this coating group will be found several pigmented coatings which yield 2-mil thicknesses per coat. That's double the build-up of ordinary phenolic coatings. Obviously, fewer coats are needed, cutting time and costs.

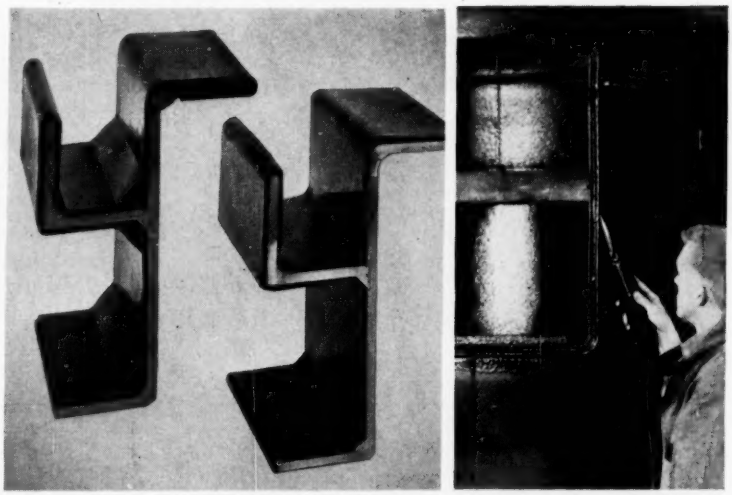
APPLICATOR SERVICE

Specialist firms experienced in applying Unichrome lining materials are located across the country. They are well set up to handle even large equipment shipped to them. They can provide fast service, and the uniform coating with greater impact resistance and improved protection for which Unichrome Phenolic Linings are noted. Send for names.

METAL & THERMIT
CORPORATION

General Offices: Rahway, New Jersey
Pittsburgh • Atlanta • Detroit
East Chicago • Los Angeles
In Canada: Metal & Thermit—United Chromium of Canada, Limited, Rexdale, Ont.

Unichrome "Super 5300" Coating sprays seamless, pore-free lining with outstanding resistance to abrasion



Section at left shows how sheet linings are applied, with seams at all sharp bends. Contrast this with the continuous, seamless "Super 5300" lining on section at right. There are no weak spots where solutions could undercut lining. (Far right): Spark testing of fume scrubber shown reveals no porosity in the protective "Super 5300" lining.

Chemical and corrosion engineers involved in new construction have shown keen interest in the advantages of Unichrome "Super 5300" Coating. Especially since it is a sprayable material, and can be applied up to 60 mils thick per coat to any object that can be heated to required baking temperature.

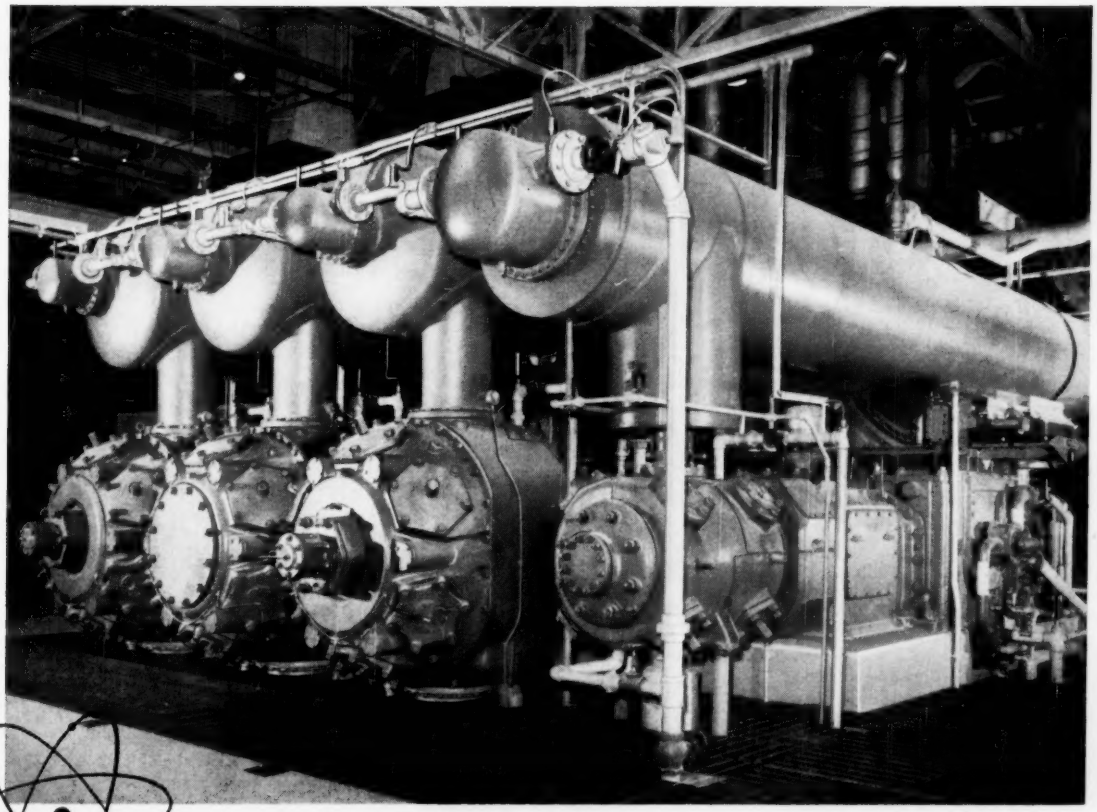
MEETS THREE IMPORTANT REQUIREMENTS

(1) Unlike usual sheet materials of rubber and plastic, "Super 5300" Coating poses no problem with seams. Since it is a liquid material, it forms a continuous coating without air pockets, eliminating potential sources of trouble, even on complicated shapes. (2) Thick and pore-free, it presents no paths for corrosive chemicals to travel to base metal. (3) It withstands abrasion and impact to a remarkable degree. Thus, it securely "seals" against corrosive attack due to penetration or to damage encountered with ordinary protective coatings.

INHERENT CORROSION RESISTANCE

A vinyl material, "Super 5300" Coating naturally resists a broad range of acids, alkalies, moisture and other active agents. Should the need arise, equipment with this coating can be patched and spot rebaked, to reform an impervious "armor" good as new.

"Super 5300" can be applied in-plant; or by expert applicators in key locations who can promptly and proficiently coat the equipment you ship them. Write Metal & Thermit for names. Or for Bulletin Chem-C-3.



Two Clark CLBA-8's serve in connection with the Engineering Test Reactor designed and built by Kaiser Engineers, Oakland, Cal., for the AEC's National Reactor Testing Station at Idaho Falls, Idaho.

In ATOMIC ENERGY too, Clark Compressors Are Giving Rugged, Reliable Service

Designed to perform engineering tests on fuel elements and components of nuclear plants, the Engineering Test Reactor provides large experimental facilities which supplement research reactors already in use.

Serving a major experiment in this reactor are two Clark CLBA-8 compressors, rated at 4,500 bhp. each. With a capacity of 15 pounds per second, they are operating at a discharge pressure of 320 psig. A 13-step combination automatic and manual pressure control allows varying discharge pressures from 50 to 350 psig.

These CLBA-8's, built on the Clark-originated balanced/opposed principle, provide maximum power on less fuel in minimum space. Their field service records in a wide range of applications attest to their high efficiency, economy of operation, and low installation and maintenance costs.

The Clark encyclopedia of experience—in design, manufacture, and application—is always at your service. For complete information on all Clark balanced/opposed compressors, call your nearby Clark engineer. Or write today for the new Composite Catalog, Clark Bros. Co., 1807 Lincoln Avenue, Olean, N. Y.

CLARK BROS. CO.

One of the Dresser Industries

Sales and service outlets in principal cities throughout the world

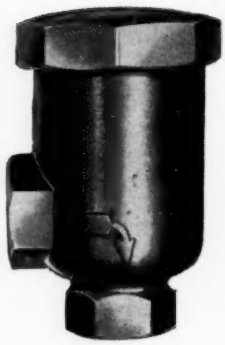
CLARK®

BALANCED / OPPOSED COMPRESSORS

need
steam traps?

name the way you want them!

TYPE A



TYPE D

TYPE C

Nicholson can supply your steam traps, exactly as you want them . . . for any service, any condition. Name the size, material, pressure, capacity you need. Types A, D, C are the ones you'll most likely use. Make your selection.

Sizes: A—from ¼" to 1". D—from ¼" to ¾". C—from ½" to 2".

Materials: Cast Iron, Cast Steel and Bronze.

Pressures: A and D—Vacuum to 200 lbs. C—Vacuum to 300 lbs.

Capacities: From two to six times greater orifice area and capacity than other traps of comparable size.

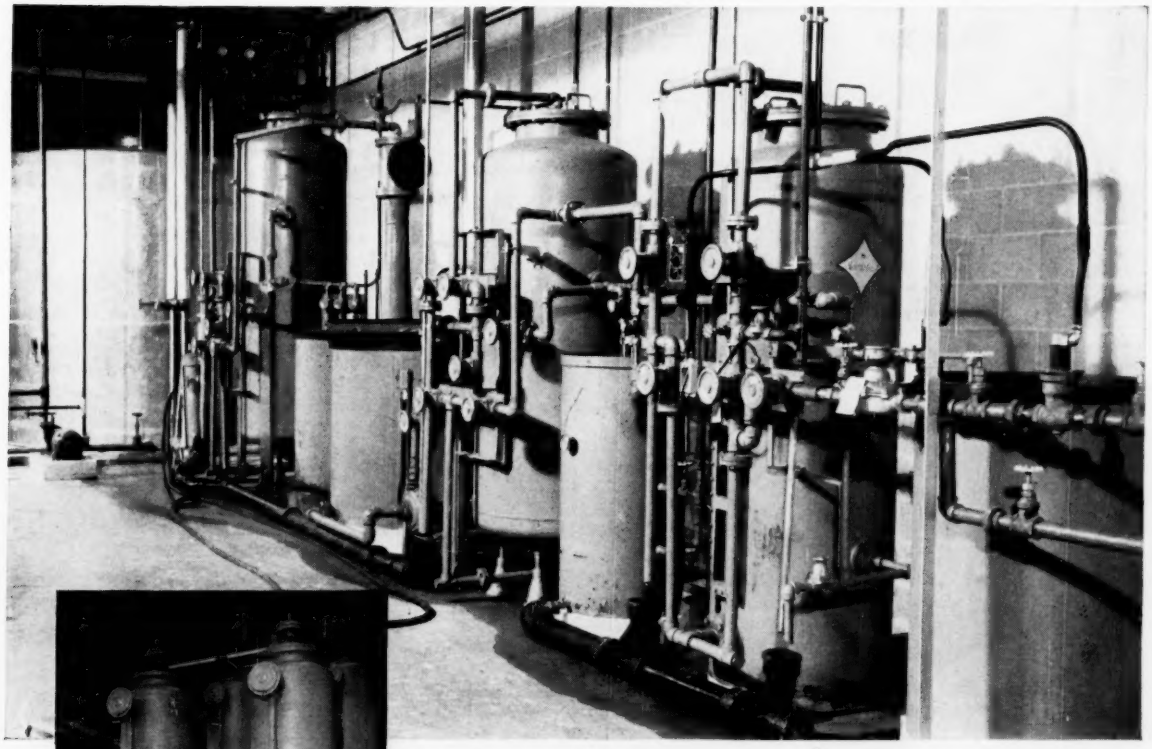
Why wonder about your steam traps . . . when you can get Nicholsons exactly as you need them for your own applications. Nicholson traps are simple in design, have only one moving part . . . a valve that discharges condensate and prevents steam loss.

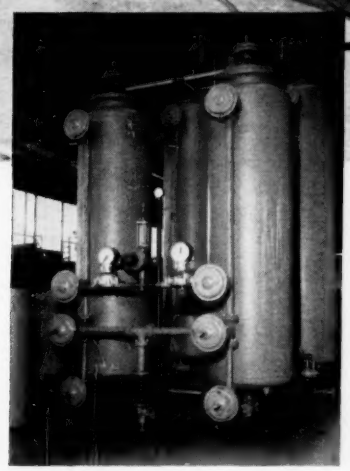
You get faster warmup, with high air-venting capacity. You eliminate costly leakage, with a powerful shut-tight valve action. You get a trap that's service-tested, when you specify Nicholson. You can try one . . . without obligation! W. H. Nicholson and Company, 12 Oregon St., Wilkes-Barre, Pa. Sales and engineering offices in 98 principal cities.

NICHOLSON
of Wilkes-Barre

INDUSTRIAL ION EXCHANGE TECHNIQUES

. . . low cost solution to specialized purification problems





EXAMPLE 1: *Purification of Formaldehyde.* Specialized anion exchange technique removes formic acid from formaldehyde. This *Industrial* semi-automatic, dual unit also "up-grades" water white formaldehyde for resin manufacture—yields final resins with resistance to off-color blush or bloom.

EXAMPLE 2: *Chemical preparation.* An *Industrial* mixed-bed ion exchange unit used for removal of sodium formate and formic acid from an organic polyhydric alcohol intermediate. Process facilitates subsequent purification by evaporation.

• Are you concerned with the removal of mineral impurities from solvent solutions—chemical intermediates—purification of glycerine—or other materials which usually require tedious, costly processing by alternate methods? If you are faced with the problem of purifying such materials, and if they contain even traces of moisture, then *Industrial*-engineered ion exchange techniques and equipment may provide a complete and inexpensive answer to your problem.

The two installations of *Industrial* ion exchange equipment illustrated here are typical of the many specialized applications of ion exchange developed and engineered by *Industrial* to meet specific chemical process industry requirements.

To evaluate the possibilities of these techniques to solve your purification problems, and to obtain an analytical study, consult *Industrial*, soon.

For general information covering *Industrial* Ion Exchange equipment, write for a copy of BULLETIN 200.

INDUSTRIAL

C-158

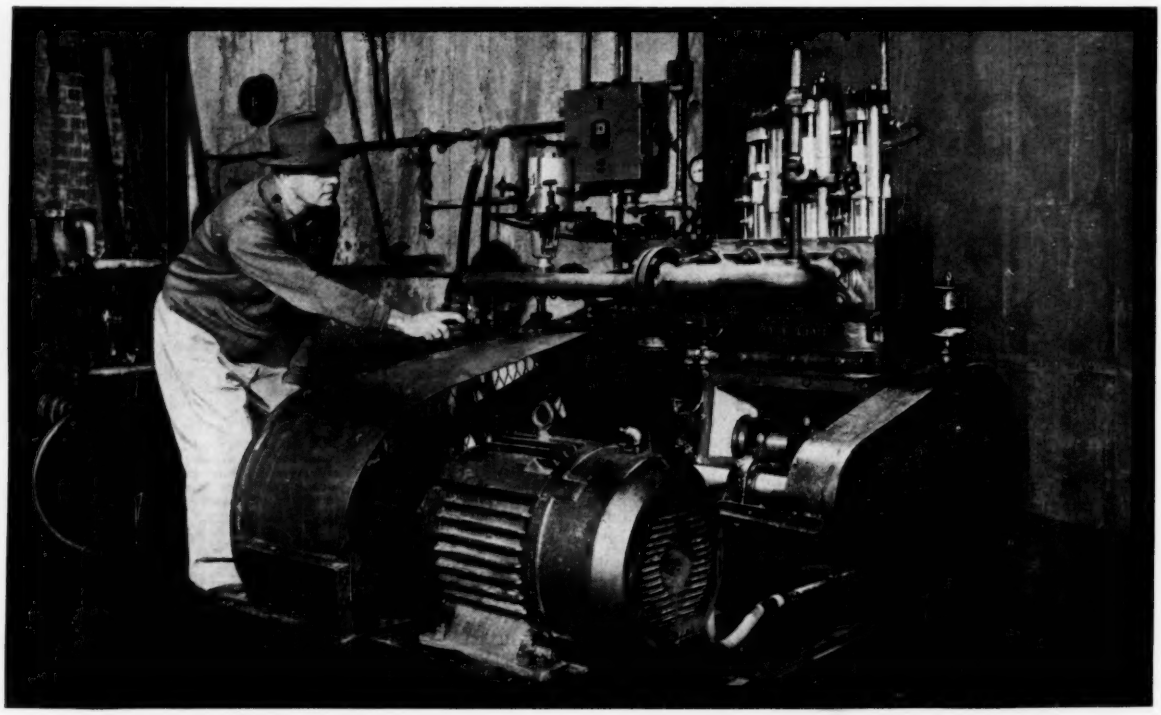
INDUSTRIAL FILTER & PUMP MFG. CO.
5918 Ogden Avenue, Chicago 50, Illinois

PRESSURE FILTERS ◆ ION & HEAT EXCHANGERS ◆ WASTE-TREATING EQUIPMENT

JACQUES WOLF & CO. SOLVES PROBLEM:

How to maintain constant, undeviating pressure in the production of highly corrosive chemicals

Precise, non-fluctuating pressures must be maintained in continuous processes at the Carlstadt plant of Jacques Wolf & Company. Erratic pressure caused by drop in volumetric efficiency could ruin an entire batch of costly material.



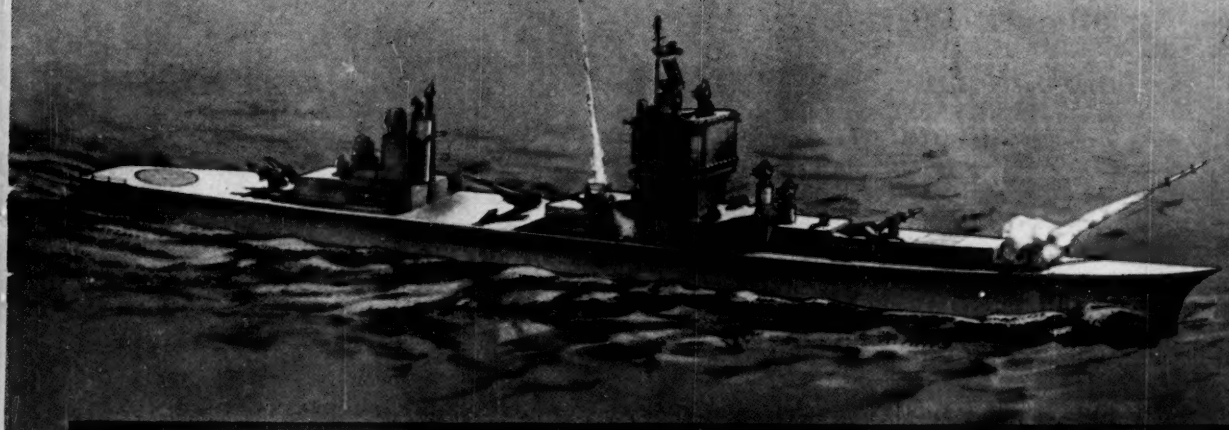
How Jacques Wolf solved the puzzle: Looking for an answer to the problem of holding constant pressure, plus that of increasing production, Jacques Wolf called on Aldrich. Aldrich engineers designed a pump which provided the proper corrosion resistance, fluid velocity and wear characteristics to insure dependable, continuous operation.

Result: After five months of use, the Aldrich Triplex Pump has met all guarantees and proven itself capable of continuous operation. Working 24 hour days, 6 day weeks, the Aldrich Triplex Pump provides the necessary pressure without fluctuation, efficiently handling both alkaline and acidic materials.

We'll be glad to send you full information on Aldrich Pumps and their advantages to you. Simply write Aldrich Pump Company, 3 Gordon Street, Allentown, Pa.

the toughest pumping problems go to ALDRICH

World's First Nuclear-Powered Surface Ship will have MIDWEST Welding Elbows

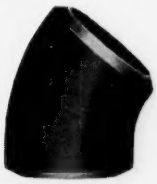


U. S. Navy's guided missile, nuclear-powered cruiser "Long Beach"

OFFICIAL U. S. NAVY PHOTOGRAPH

Special Fittings are "ROUTINE" for Midwest

Stainless Steel
S.R. 102° Elbow
with tangent on one end.



Stainless Clad
S.R. 39° Elbow
with tangent on one end.

Stainless Steel
S.R. 90° Elbow
with tangent on both ends.

Special Elbows (dimensions, tangents, wall thicknesses and materials) are easily provided by the exclusive and flexible Midwest method. Elbows are available in any material that can be secured as plate, which also means better delivery. Closer tolerances are inherent in the Midwest process. Quality control always exceeds Code requirements.

Shown here are three of the special stainless steel and stainless-clad elbows made by Midwest for the "U.S.S. Long Beach". All reactor coolant piping must meet extremely rigid specifications because of the difficult service. Special quality controls, such as ultrasonic testing, intergranular corrosion tests, dye checking, radiography, and ring flattening tests were used one or more times at various stages of manufacture from the raw material to the finished fittings. Special quality standards for soundness of metal, "water clear" welds, dimensional accuracy, and surface finish were satisfied.

The U. S. Navy's first nuclear-powered surface ship, the "Long Beach", will introduce a radically new concept in defense capabilities. She will operate offensively and independently of other forces under conditions of both nuclear and non-nuclear warfare against airborne, surface or under-sea opposition. In addition to equipment and weapons for detecting and destroying enemy submarines, she will carry the Navy's modern guided missiles.

The piping for the atomic reactors being designed and developed by the Westinghouse Electric Corporation will use a large number of special heavy wall stainless steel Midwest Welding Elbows. This is not the first atomic project for which Midwest Welding Fittings have been used. In fact, when the nuclear propulsion program first began, Midwest furnished special welding fittings for the "Nautilus" prototype installation at Arco, Idaho.

Whether or not you are concerned with nuclear power, Midwest Welding Fittings (both stock and specials) will do a better job for you. Ask your Midwest distributor or write us for Catalog 54, which tells you why.

MIDWEST PIPING COMPANY, INC.

Main Office: St. Louis 3, Missouri (P.O. Box 433)

Plants: St. Louis, Clifton, N. J. and Los Angeles

SALES OFFICES: ASHEVILLE (BOX 446, SKYLAND, N.C.)
ATLANTA 9—72 ELEVENTH ST., N.E. • BOSTON 27—426 FIRST ST.
CHICAGO 3—79 WEST MONROE ST. • CLEVELAND 14—616 ST. CLAIR AVE.
HOUSTON 2—1213 CAPITOL AVE. • LOS ANGELES 33—520 ANDERSON ST.
MIAMI 34—2103 LE JEUNE RD. • NEW YORK 7—50 CHURCH ST.
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7918

MIDWEST WELDING FITTINGS IMPROVE PIPING DESIGN AND REDUCE COSTS

Here's a pump you can use anywhere GOULDS self-priming centripetal pump (Fig. 2520)

pumps liquid... air ... liquid and air

As a scavenger . . . handy transfer . . . for cleaning up—which way can this versatile Goulds pump work for you?

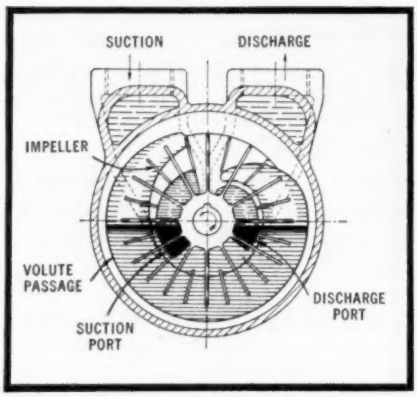
You can use it for almost anything.

Because it pumps air and liquid in any combination, it handles foaming solutions and emulsions easily. It's ideal for pilot plant work, for cleaning operations.

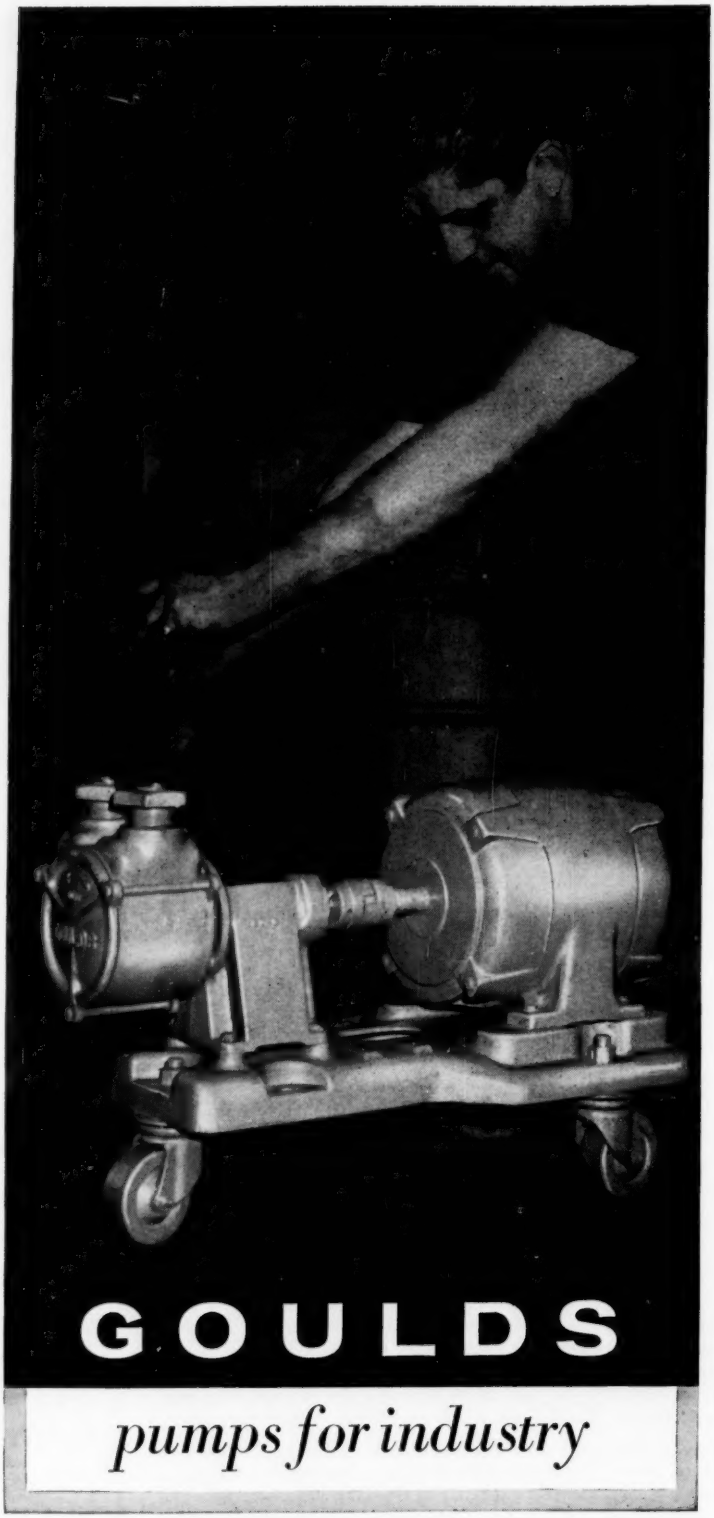
Once primed, it stays primed. It won't air-bind. Even with loops or leaks in your suction line, its high air-handling capacity will keep liquids moving.

Compact, lightweight, portable—it's ready in all-iron construction, or in stainless steel for corrosive service. It's offered as a mobile unit (illustrated), pump-motor unit, or pump only for V-belt drive. The pump itself weighs 42 pounds. With 1½ inch suction and discharge, capacities go to 60 GPM, heads to 80 feet.

There's a complete description of the Liquid Ring Pump in Bulletin 725.6; you can get a copy from us or from your Goulds representative.



This new self-priming Goulds pump eliminates air-binding by a unique use of *centripetal* action. The impeller forces liquids along a volute casing, building up pressure as the liquid moves to the narrow end. This pressure sets up a liquid piston action between each set of blades, forcing liquids to the center of the pump. The liquid piston forces any air entrapped in the center up through the outlet.

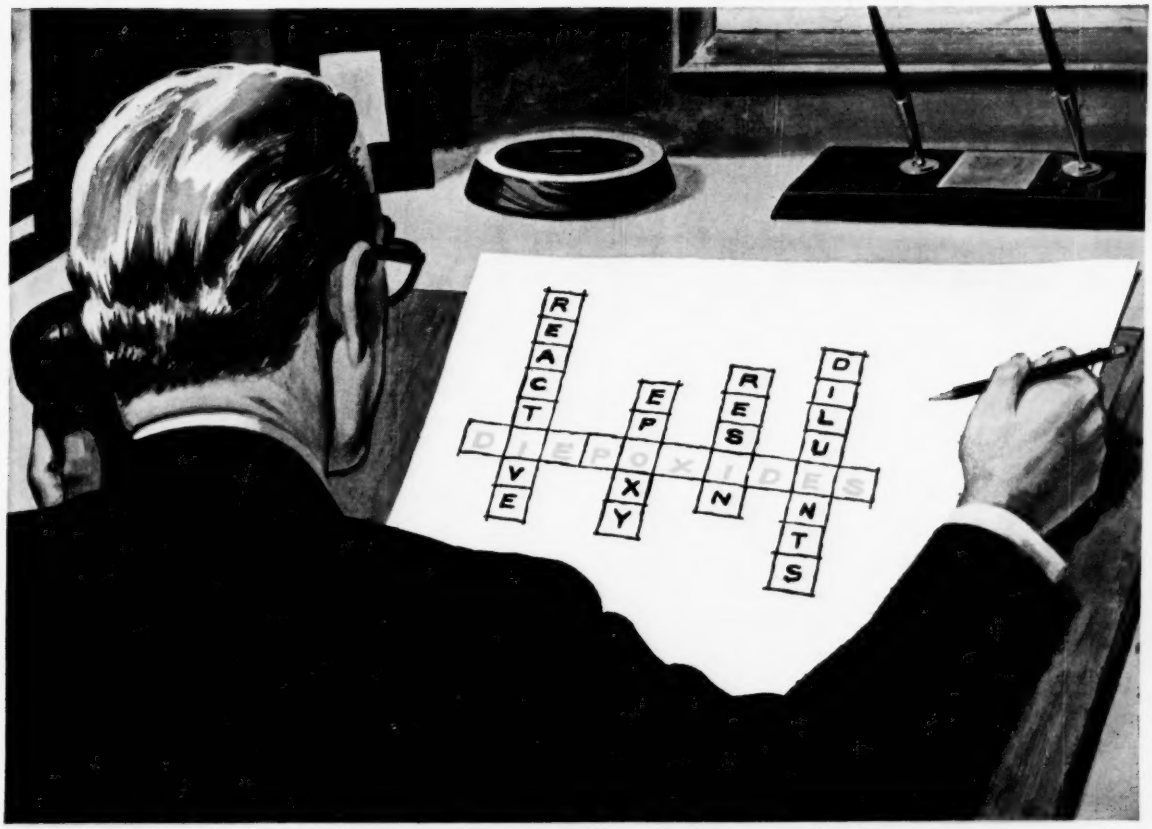


GOULDS PUMPS, INC.

Main Office and Works, Seneca Falls, New York

Branches and Representatives in principal cities

In Canada: The A. R. Williams Machinery Co., Ltd.



Are Becco DIEPOXIDES an answer to your resin problems?

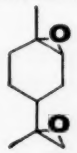
Becco's new diepoxides – Dicyclopentadiene Dioxide and Limonene Dioxide – combine the reactivity of the epoxy group with their difunctional nature. Initial Becco research indicates their principal applications will be as constituents in epoxy and other resin systems. Here they may function as diluents, crosslinking agents, or modifiers of resin properties.

Other applications for the new diepoxides conceived by Becco chemists are as intermediates in the preparation of perfumeries, cosmetics, pharmaceuticals, adhesives, lubricants and lubricant additives, and in organic synthesis.

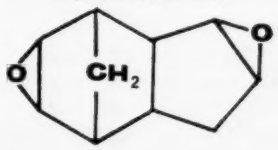
We invite you to write for technical information and research quantities of Dicyclopentadiene Dioxide, a white, crystalline powder, or Limonene Dioxide, a clear, colorless liquid. Ask, too, for our bulletins describing Becco monoepoxides – Octylene Oxide, Dodecene Oxide, C_{16}-C_{18} Olefin Oxide, alpha-Pinene Oxide and Limonene Monoxide (Dipentene Oxide) – which are available in semi-commercial quantities.

STRUCTURES

Limonene Dioxide



Dicyclopentadiene Dioxide



Progress in Peroxygens

BECCO

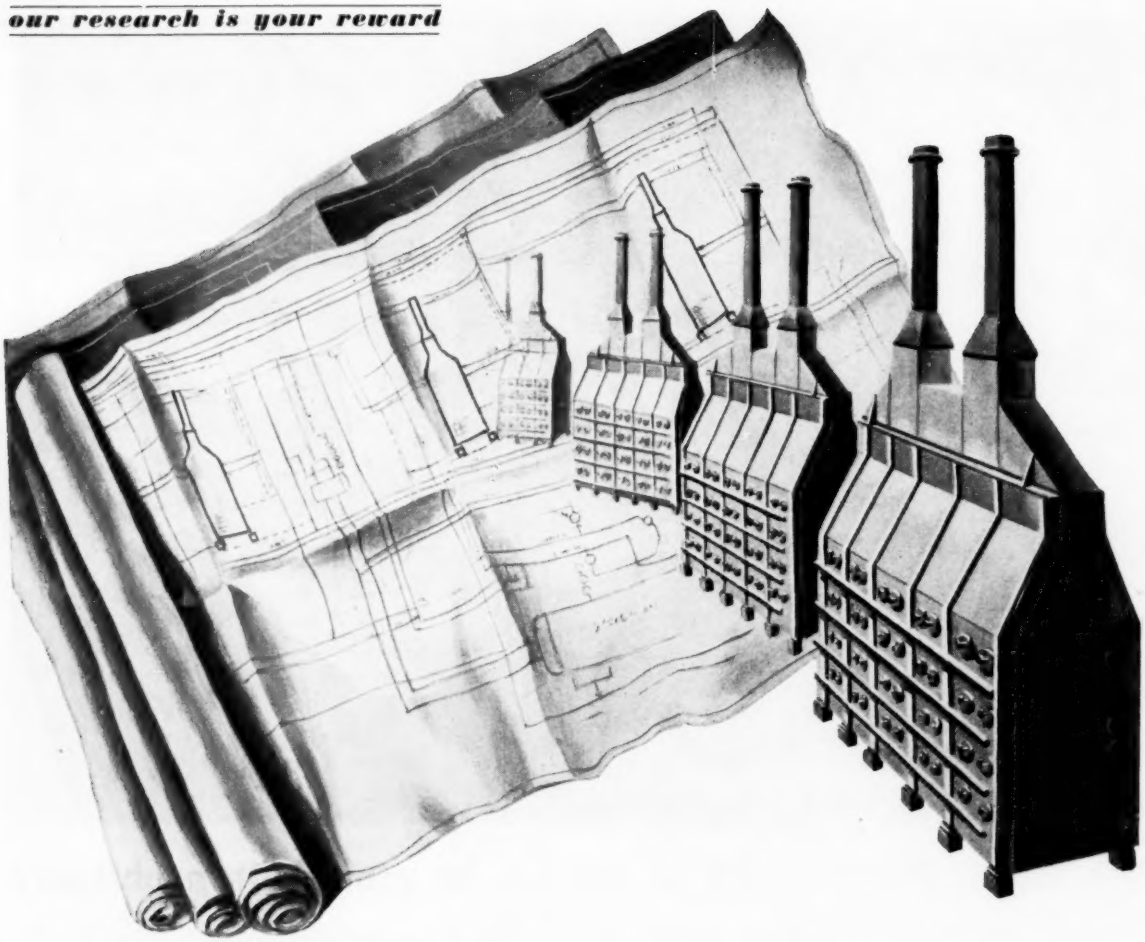
BECCO CHEMICAL DIVISION

Food Machinery and Chemical Corporation
Station B, Buffalo 7, New York

fmc
FOOD MACHINERY AND CHEMICAL CORPORATION

FMC CHEMICALS INCLUDE: **BECCO** Peroxygen Chemicals • **WESTVACO** Phosphates, Barium and Magnesium Chemicals • **WESTVACO** Alkalis, Chlorinated Chemicals and Carbon Bisulfide • **NIAGARA** Insecticides, Fungicides and Industrial Sulphur • **OHIO-APEX** Plasticizers and Chemicals • **FAIRFIELD** Pesticide Compounds and Organic Chemicals

our research is your reward



73 Selas heaters in pyrolysis service demonstrate these extra benefits of Gradiation® processing

The difficulty in heat processing materials in conventional tubular heaters is to achieve uniform application of heat on the tube wall. Flame impingement or excessive heat on one side of the tube outer wall hastens metal degradation and, especially with highly corrosive feed stocks, tube corrosion.

Selas Gradiation overcomes that difficulty by distributing radiant heat uniformly along and around the entire tube wall, minimizing scaling and corrosion. Maximum allowable heat rate may thus be used in establishing coil length. The result: shorter lengths of tubes, fewer tubes, more compact furnaces. Obviously, tube replacement—when required—is less costly.

Selas heaters in pyrolysis service are designed to process a variety of feed stocks interchangeably. Burners are individually adjustable. Response to controller demands is split-second. This quality of Zone Control makes Selas heaters exceptionally versatile; makes them, as one processor has said: "The heart of the refinery."

Selas Gradiation heaters for the chemical, petrochemical and petroleum industries may be field-erected or shop-assembled. Selas also builds Econotherm* heaters for use where operations require materials to be heated to below decomposition temperatures.

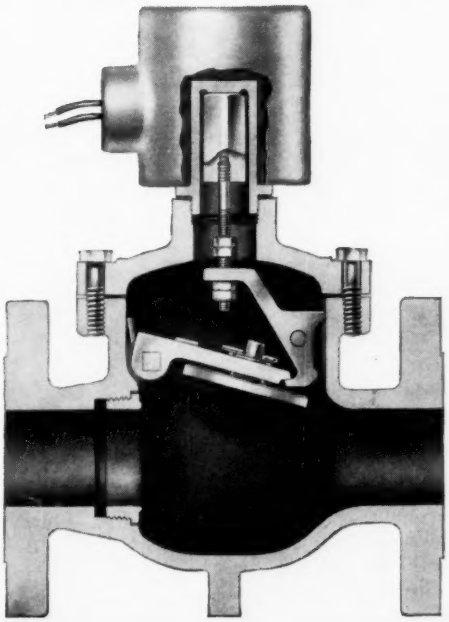
Send for reprint "Try the Gradiation Heater for Economic Ethylene Production" and Bulletin 145 "Gradiation Heating for Petroleum and Chemical Processing." Selas engineers will be glad to discuss your heat-processing requirements with you. Selas Corporation of America, Dresher, Pa.

Gradiation is a registered trade name of Selas Corporation of America. * Trade Name

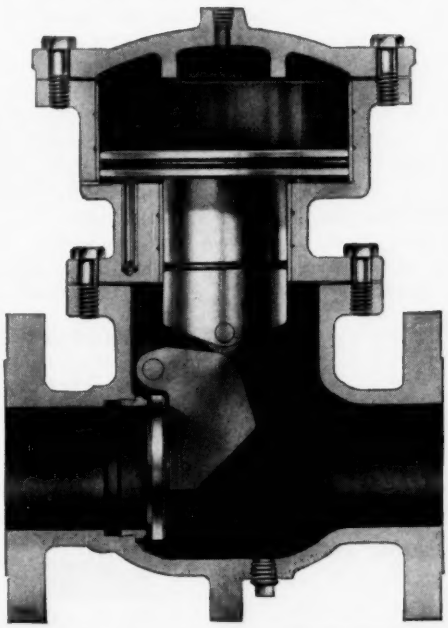
SELAS
CORPORATION OF AMERICA
DRESHER, PENNSYLVANIA

Heat and Fluid Processing Engineers
DEVELOPMENT • DESIGN • CONSTRUCTION

Latch type valve closes instantly



Piston type valve opens instantly



Coppus Sentry® Valves Give Split-Second Action

Coppus Sentry Valves automatically protect property, materials, and processing with their quick, positive action. These are all full-flow valves for use on liquid and gas lines.

The latch-type valves stop flow instantly, automatically. They may be actuated by excess flow, overpressure, underpressure, overtemperature; or by energizing or de-energizing a solenoid.

These valves remain closed until manually reset. They are extremely popular in the chemical, petroleum and gas industry.

The piston type valve opens instantly. Opening and closing of this valve may be from any remote location — either automatically or manually. It is ideal for deluge systems.

Sizes run from 1½" to 8".

To get a more detailed story on this remarkable line of Coppus Sentry Valves, use the coupon to ask for Bulletin 500. Coppus Engineering Corp., Worcester 2, Mass.

ANOTHER COPPUS "BLUE RIBBON" PRODUCT

COPPUS ENGINEERING CORPORATION
225 Park Avenue, Worcester 2, Mass.

Please send Bulletin 500

Name.....

Company .....

Address.....

Kathabar® systems deliver air continuously at dry bulbs and dew points down to minus 90 F

You know how much money you could save your company if you could get a continuous supply of air at conditions anywhere below 32 F dry bulb and dew point. You also know how free you could be if you didn't have to worry about frost, coolant temperature, and any other obstacles to low-temperature operation.

These profits are immediately available to you in a Kathabar-engineered air conditioning system. Specify any sub-freezing air conditions you require, and Kathabar engineers will meet your specs with a system which is economical, continuous, automatic, and simple.

sample conditions

The conditions you want may be in this group of Kathabar-engineered installations:

PROCESS	AIR OFF *dry bulb*	KATHABAR *dew point*
Ordnance testing	-90 F	-100 F
Wind tunnel	-47 F	-61 F
Candy bar chilling	0 F	-19 F
Photo film chilling	6.5 F	2 F
Glass laminating	23 F	-2 F
Brewing	28 F	10 F
Chemical processing	24 F	5 F

These samples merely hint at the versatility of Kathabar systems. They will give you dew points as low as minus 90 F under pressure or vacuum, if you want them.

pay-off points

To you, the possibility of a continuous process at sub-freezing air temperatures might be the greatest advantage of a Kathabar system. To someone else, its precise control of dry bulb and dew point is the chief attraction. Others say they gain most from Kathabar engineers' knowledge of materials and processes.

All Kathabar low-temperature applications have clear advantages in common. They tremendously increase cooling efficiency by eliminating frost. This prevents refrigeration freeze-ups, avoids cyclic operation, and often gives better cooling with less tonnage.

They eliminate defrosting shutdowns and the need for duplicate coils.

With "Kathene" solution, the most potent chemical absorbent known, a 10 F to 25 F dew point depression may be obtained between the outlet air dew point and the cooling medium temperature. There is no need to cool the air or the absorbent to the desired dew point temperature. There is exact control of dew points without vaporization or "carryover." Regeneration of the absorbent is automatic and continuous.

Operation and maintenance are simple and economical. In many cases, Kathabar systems can be adapted to existing air conditioning systems.

who uses Kathabar systems

Kathabar systems make profits out of air for these industries:

Atomic Energy	Machining
Breweries	Marine
Cake Mix	Matches
Candy	Meat
Cellophane	Offices
Cellulose	Ordnance
Cereals	Paper
Chemicals	Pharmaceuticals
Coffee	Plastics
Comfort	Printing
Compressors	Rockets
Cookies	Rubber
Electronics	Sanitaryware
Explosives	Shellac
Film	Sugar
Foundries	Testing
Gelatin	Textiles
Glass	Transformers
Glue	Transistors
Gum	Vacuum Tubes
Hospitals	Varnish
Hotels	Waterworks
Lacquer	Wire
Lenses	Yeast

how they use Kathabar systems

Many of these industries use Kathabar systems for obtaining continuous air at sub-freezing dry bulbs and dew points. Others use them to (1) maintain spaces below 80 F and 55% RH; (2) maintain spaces at specific low bacteria or mold count; (3) eliminate wet floors, walls, equipment; and (4) improve drying processes.

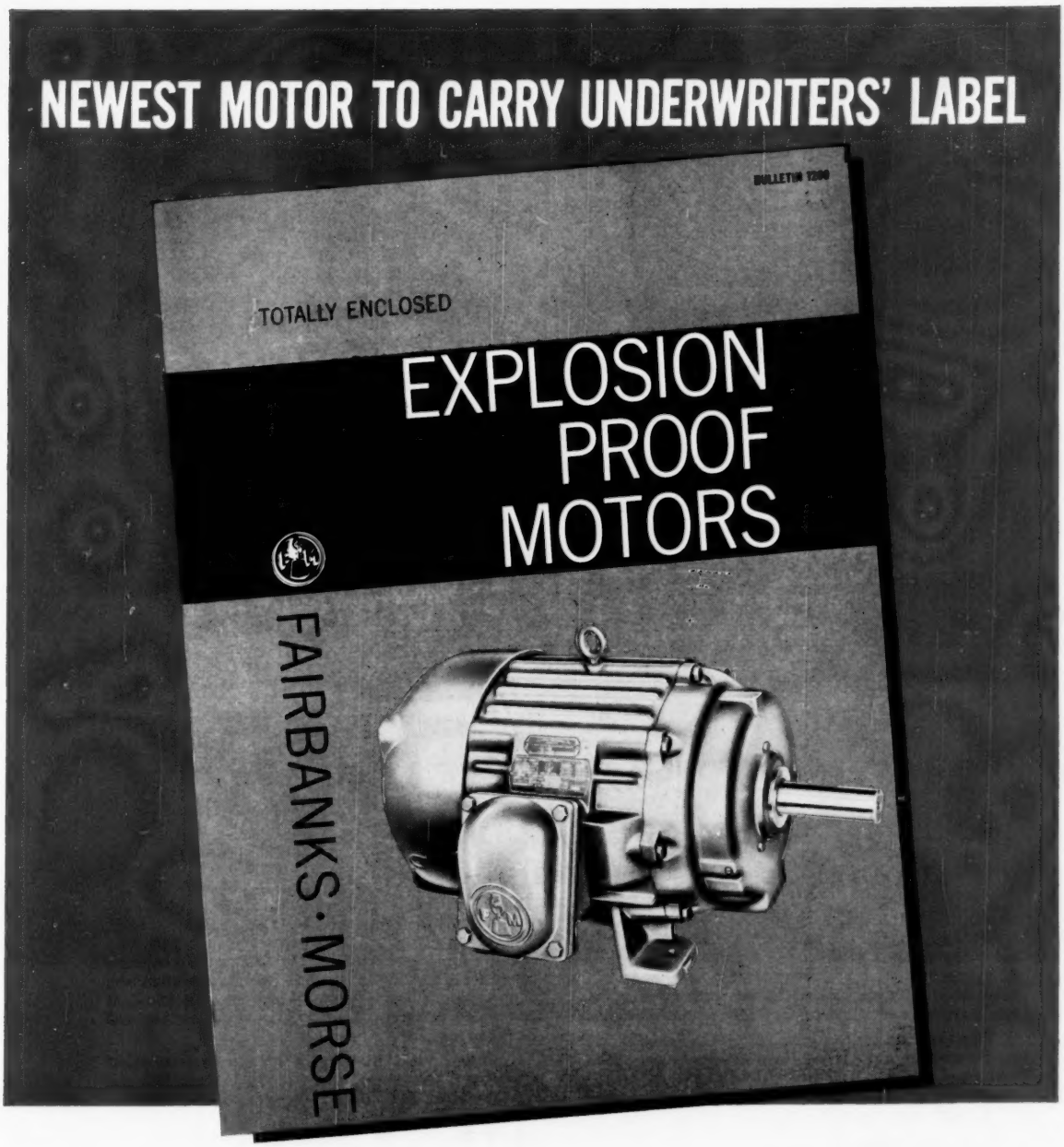
Write for additional information; you'll get it by return mail.

send description of your problem

Air Conditioning and Drying Division
SURFACE COMBUSTION CORPORATION
2380 Dorr Street Toledo 1, Ohio

Kathabar systems by Surface

NEWEST MOTOR TO CARRY UNDERWRITERS' LABEL



FAIRBANKS-MORSE

EXPLOSION PROOF

All new inside and out—new, rugged frame design . . . for new, improved performance in all Class I, Group D, and Class II, Group E, F and G hazardous locations.

Get full information . . . send for Bulletin 1200 on new Fairbanks-Morse line of totally enclosed, explosion-proof motors. Write today: Fairbanks, Morse & Co., Dept CE-5, Chicago 5, Ill.

FAIRBANKS-MORSE
a name worth remembering when you want the BEST

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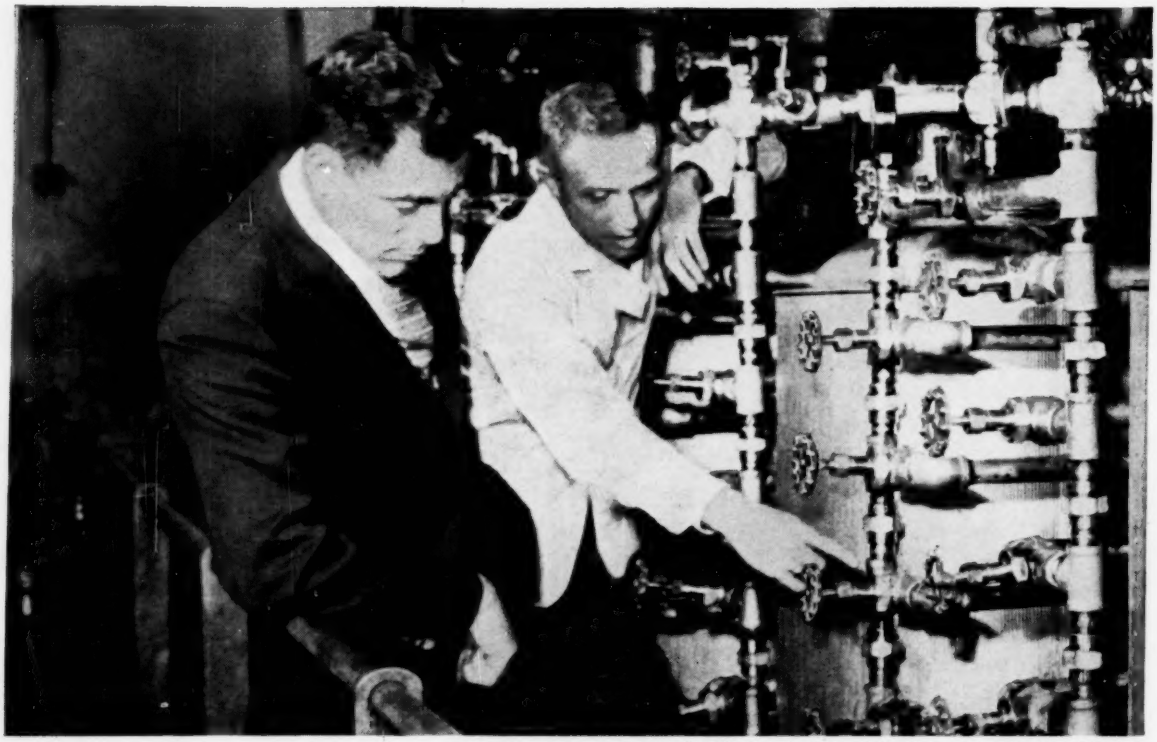


Joseph Smindak (right), Plant Engineer, Coffee Instants, Inc., Flushing, N.Y. Left, Michael De Piano, N.Y. representative, Cooper Alloy Corp. Foreground, Cooper Alloy 1" stainless Union Bonnet Globe Valves.

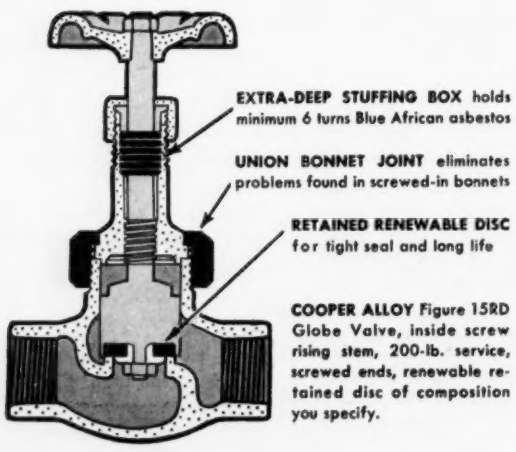
SMINDAK of COFFEE INSTANTS, INC.

Tells why he specifies Cooper Alloy for stainless steel valves and fittings

Q. Mr. Smindak, why does Coffee Instants, one of the nation's leading instant coffee processors, use stainless valves and fittings in processing their product?
A. To protect product purity, a must with us as with most other food processors. Contact with other metals can degrade flavor and aroma; stainless steel does not.

Q. Why Cooper Alloy?
A. Because of the special Cooper Alloy construction features I find combined in no other brand. On these Cooper Alloy union bonnet globe valves, for example, we like the ease of operation and the low maintenance; the fact that it removes a threaded joint from product contact; and in particular, the extra-deep square-compression stuffing box which reduces maintenance, gives a tighter seal at stem. Then too, the excellent service we get from Cooper Alloy sales people and distributors.

Q. You don't find these features in any competing valve?
A. Frankly, not one has them all. That's why, for our stainless valves *and fittings*, we insist on Cooper Alloy.


EXTRA-DEEP STUFFING BOX holds minimum 6 turns Blue African asbestos
UNION BONNET JOINT eliminates problems found in screwed-in bonnets
RETAINED RENEWABLE DISC for tight seal and long life
COOPER ALLOY Figure 15RD Globe Valve, inside screw rising stem, 200-lb. service, screwed ends, renewable retained disc of composition you specify.

YEARS AHEAD IN DESIGN SUPERIORITY! No matter what your valve type—globes, gates, angles, checks, or Y's—the Cooper Alloy model's outstanding design features will be important to you. Cooper Alloy, with 35 years of pioneering experience in stainless steel, does not merely adapt existing brass and iron valve patterns; it creates valves *designed to be cast in stainless!* **Check the special design features of valve shown at left.**

As the little CA man below is saying: *"You Can Tell A Cooper Alloy Valve As Far As You Can See It!"* Write today for *your* copy of our folder "Design Factors In Stainless Steel Valves." The Cooper Alloy distributor near you will be glad to show you the complete line of Cooper Alloy valves *and fittings*, and their advantages. He can serve you promptly from local stocks.

COOPER ALLOY
Corporation • Hillside, New Jersey
VALVE & FITTING DIVISION
THIRTY-FIVE YEARS OF STAINLESS STEEL PIONEERING

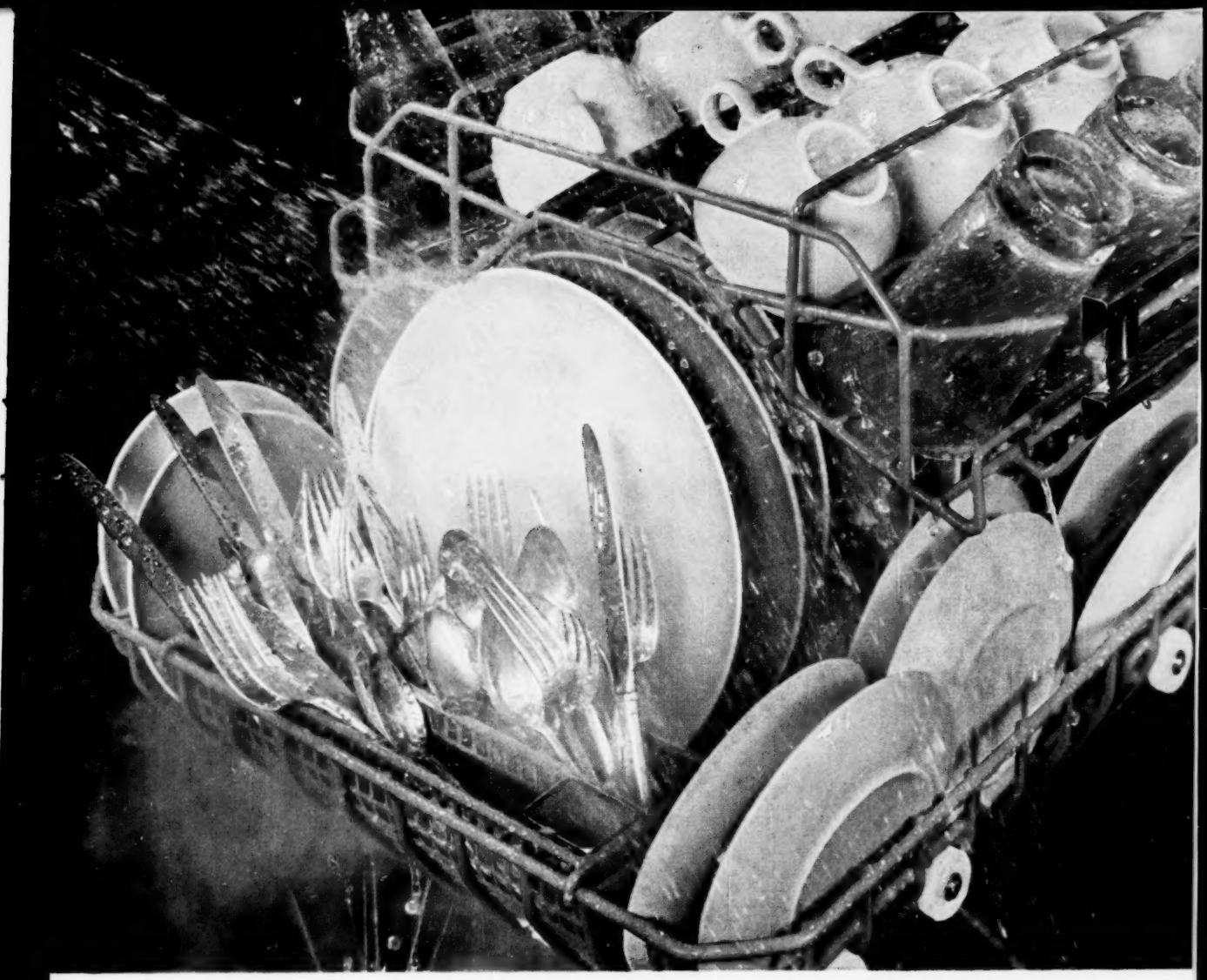
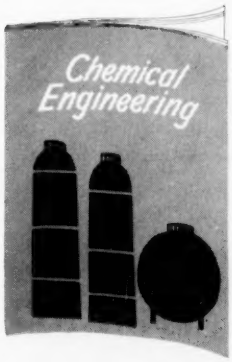


PHOTO COURTESY THE ANACONDA COMPANY

The Chemical Engineer washes 300 million dishes a day

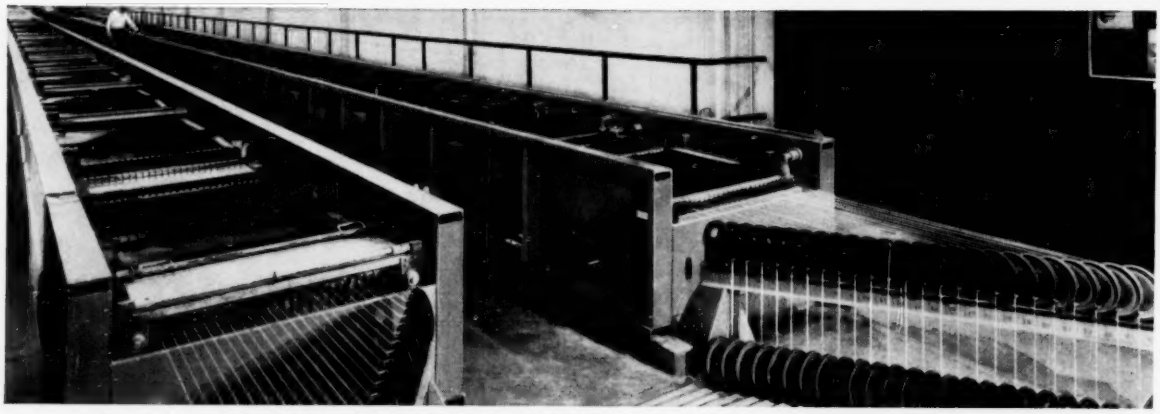
Detergents are only one of the myriad products made possible by the Chemical Engineer and his technology.

Wherever he is in industry . . . and his activities range from atomic energy and rocket fuels to drugs and detergents . . . the chemical engineer is your most critical buying factor. He creates products, controls processes, designs and builds plants. His technology ties the industry together. Naturally, he recommends and specifies at every stage in the buying procedure. If you sell him first, you'll be way up front when the need for new equipment and raw materials arises.

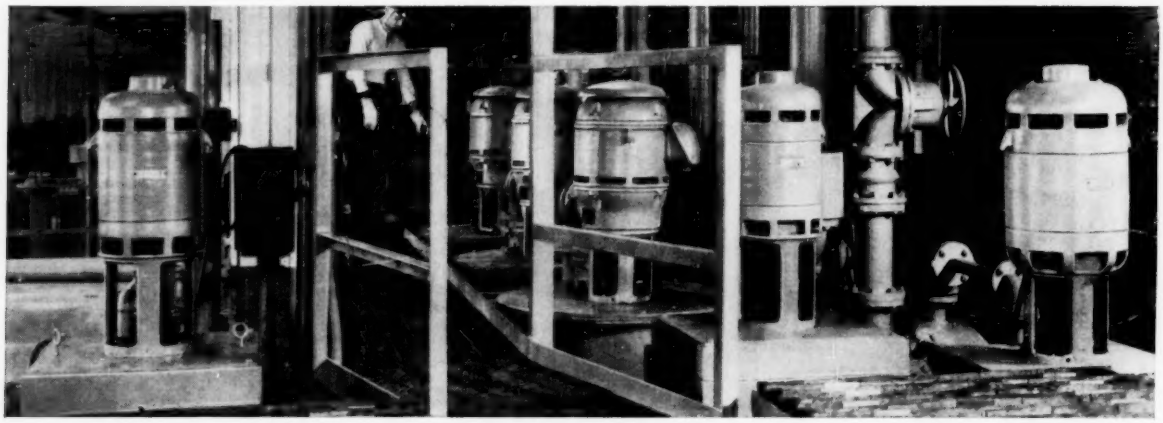


For more than 55 years, the one publication completely dedicated to this man has been CHEMICAL ENGINEERING . . . the solid 3 to 1 choice among chemical engineers in all functions, in all industry. This year you can reach them with more timeliness and impact than ever before. CHEMICAL ENGINEERING, A McGraw-Hill Publication, 330 W. 42nd St., New York 36, N. Y.

Published every other monday
for Chemical Engineers in all functions



For high product quality, solutions are constantly circulated through these tanks used to copper plate steel wire.



For low pump maintenance, parts contacting copper fluoborate electrolyte and 4 other corrosives are cast of nickel-containing stainless steels.

Cast stainless steels bolster life of pumps circulating copper fluoborate electrolyte

... brush off aggressive attack by this and 4 other corrosives

You can throw a lot of copper from a copper fluoborate solution.

But when pH is under 1 and the bath ranges up to 135°F, the corrosive capabilities of this electrolyte deserve respect.

Western Electric Company's Point Breeze Works protects important units with nickel-containing stainless steels. Take the vertical Aurora* pumps that circulate the fluoborate. Chromium-nickel stainless castings are specified for every part below the base plates ... including support and discharge pipes. For studs and nuts, corresponding wrought grades of chromium-nickel stainless are called for.

Type CF-8M alloy castings are used for several 50-gpm pumps in filtering and solution handling. Type CN-7M alloy castings are employed in four 800-gpm units circulating electrolyte from tanks to cells.

CF-8M (20% Cr, 11% Ni, 2.5% Mo, 0.08% max. C) and CN-7M (29% Ni, 20% Cr, 3% Cu, 2% Mo, 0.07% max. C) are Alloy Casting Institute designations.

These nickel-containing cast stainless alloys are also used in pumps handling 4 other severe corrosives in the plating process ... mixed alkalies at 190°F; 15% sulphuric acid at 90°F; hydrofluosilicic acid at 90°F; and lead fluosilicate at 150°F.

Chromium-nickel stainless steels exercise an effective restraint over corrosives like these. That's plainly shown in the Inco booklet, "Corrosion Resisting Properties of the Austenitic Chromium-Nickel Stainless Steels." Let us send you a copy.

*Aurora Pump Division of New York Air Brake Company, Aurora, Illinois.

THE INTERNATIONAL NICKEL COMPANY, INC.
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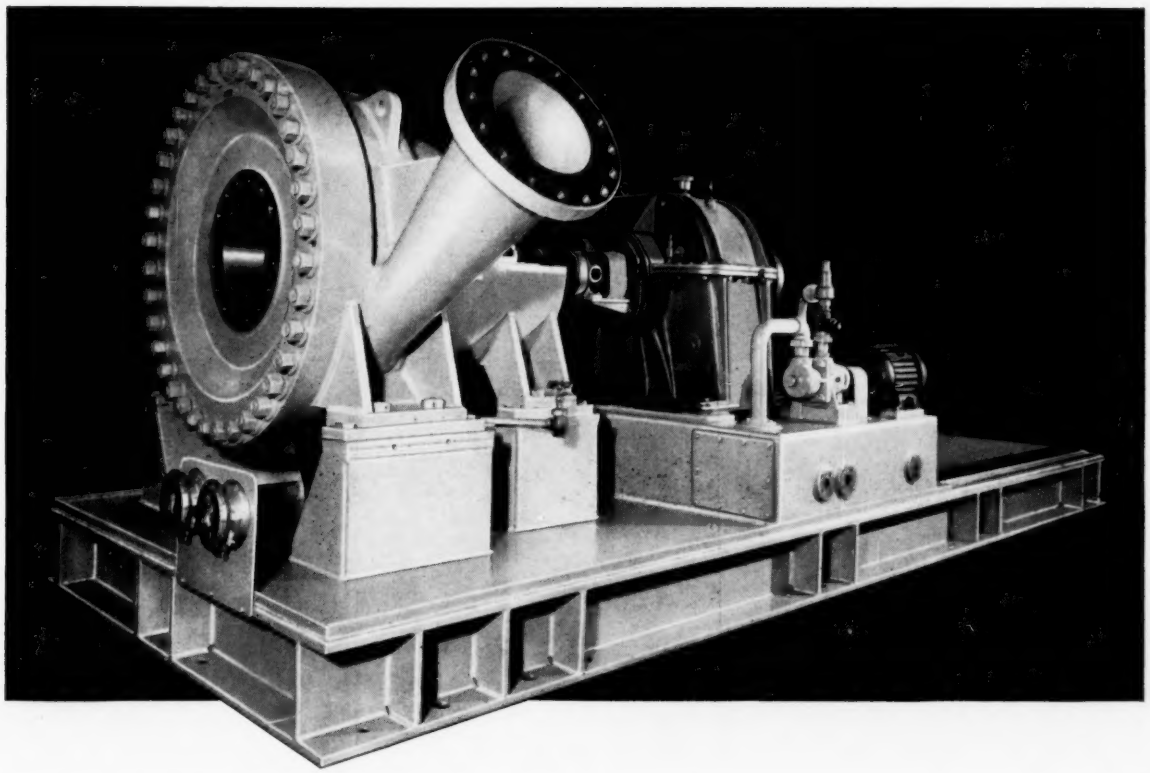
INCO NICKEL

NICKEL ALLOYS PERFORM BETTER LONGER



NEW

Single-Stage Barrel-Type
Allis-Chalmers Compressor

Boosts High Pressure Gas to Higher Pressure Levels in Range of 50 to 500 psia.

THIS new Allis-Chalmers development extends the range of single-stage compressors into high pressure levels previously handled by reciprocating type units.

The new compressor has all the advantages of a centrifugal compressor — compactness, pulsation-free operation, few wearing parts, easy maintenance.

The unit shown above, now in successful operation, boosts 3690 cfm of air from an inlet pressure of 185 psia to a discharge pressure of 240 psia. It is driven through a speed-up gear by an Allis-Chalmers 1250-hp motor.

The casing consists of three principal parts: the casing cylinder, a bolted casing head and a fabricated casing pedestal. A diaphragm which forms the gas diffuser passage is inserted into the casing cylinder. Excellent gas sealing is assured, since there is only one shaft extension and only one casing joint to seal against gas pressure.

For details, including a sectional view of this new compressor, call your nearby A-C representative, or write Allis-Chalmers, Industrial Equipment Division, Milwaukee 1, Wisconsin.

ALLIS-CHALMERS

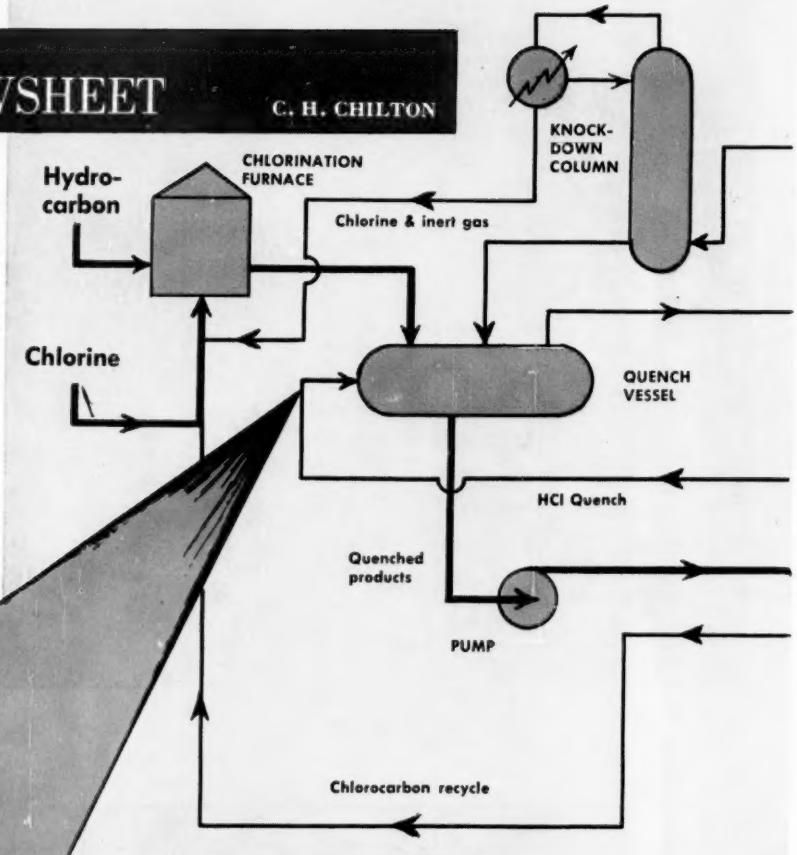
A-C ALLIS-CHALMERS

A-5728

PRACTICE . . .

PROCESS FLOWSHEET

C. H. CHILTON



Patented quench system quickly douses hot gaseous products from chlorination furnace in aqueous HCl, minimizes side reactions that chop into process efficiency.

Quick HCl Chill Highlights New Perchlor Process

Perchloroethylene — widely used drycleaning and degreasing solvent —is now being produced by a new process that bypasses multistep routes commonly traveled, yields perchlor via one-step hydrocarbon chlorination. Besides raw material savings (flowsheet can accommodate any light hydrocarbon), process also claims lower capital investment costs and labor savings resulting from flowsheet's lone reaction step.

Pechiney, one of Europe's major chemical producers, recently brought this process on stream in a new plant at St. Auban, France. With a capacity of up to 20 million lb./yr., plant is first commercial installation to be built around flowsheet engineered by Scientific Design Co. of New York.

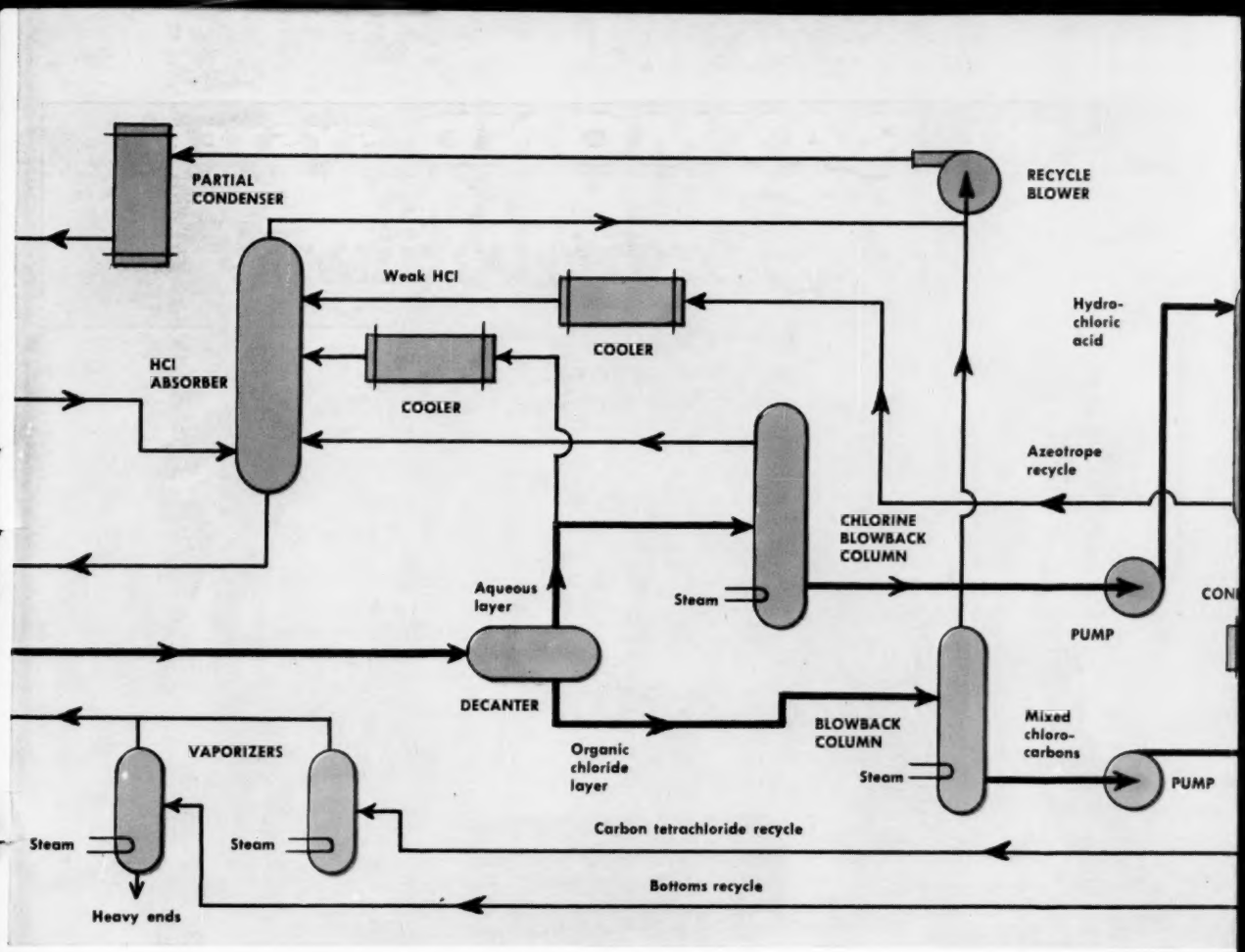
▶ **Perchlor Going Up** — Perchloroethylene has been gaining in popularity, both in the U.S. and abroad. Among chlorocarbon cleaning solvents, perchlor has been steadily nudging carbon tetrachloride to the sidelines because of perchlor's lower toxicity and lower vapor pressure.

About 180 million lb. of perchlor is used yearly in this country, most going to drycleaning plants. Currently, perchlor accounts for 35% of total drycleaning volume in the U.S., but industry estimates peg perchlor's share at 50% by 1965.

Accounting for this swing to perchlor is the drycleaning trend towards small neighborhood cleaning units. Zoning laws in these areas require nonflammable solvents in cleaning plants; perchlor's nonflammability plus its adaptability to small cleaning machines makes it a logical choice for these small installations.

Perchlor's rival, Stoddard solvent (a naphtha-based cleaner), although flammable, is cheaper than perchlor and so is used in high-volume cleaning operations. With the swing to small, flexible cleaning units, any process that will put perchlor in a more competitive economic position (it's currently near the $2/gal. mark) will attract a lot of attention.

Unfold Flowsheet



▶ **For Purity, Quench Quickly**—Main engineering innovation in the SD flowsheet is quenching system after chlorination furnace; rapid chilling of hot (around 1,000 F.) chlorination products is required to cut short side reactions. Scientific Design has patented a novel technique for quenching hot exit gases with aqueous hydrochloric acid containing at least 19% HCl (U.S. 2,746,998).

Quenching with liquid chlorocarbons has been proposed as an alternative in this type of process, but SD found this method gives substantial amounts of side products. HCl quench minimizes side-product reactions and gives byproduct HCl in concentrated form for recovery.

According to SD patent, exit gases from furnace are rapidly chilled by contacting a 21-36% HCl stream at 120 F. Liquid from quench (HCl and condensed products) at 140 F. separates into an upper aqueous layer and lower organic chloride layer in a hold drum.

Part of aqueous layer is cooled to 120 F. and pumped to quench system; rest is stripped to recover anhydrous HCl. Organic chloride layer is processed to retrieve perchloroethylene.

▶ **Economics Hold Sway**—Cornerstone of this one-step chlorination process is raw material economics. Many older perchlor installations are built around the expensive acetylene route—requiring four reaction steps. Pechiney was producing perchlor by acetylene process before its new plant swung on stream.

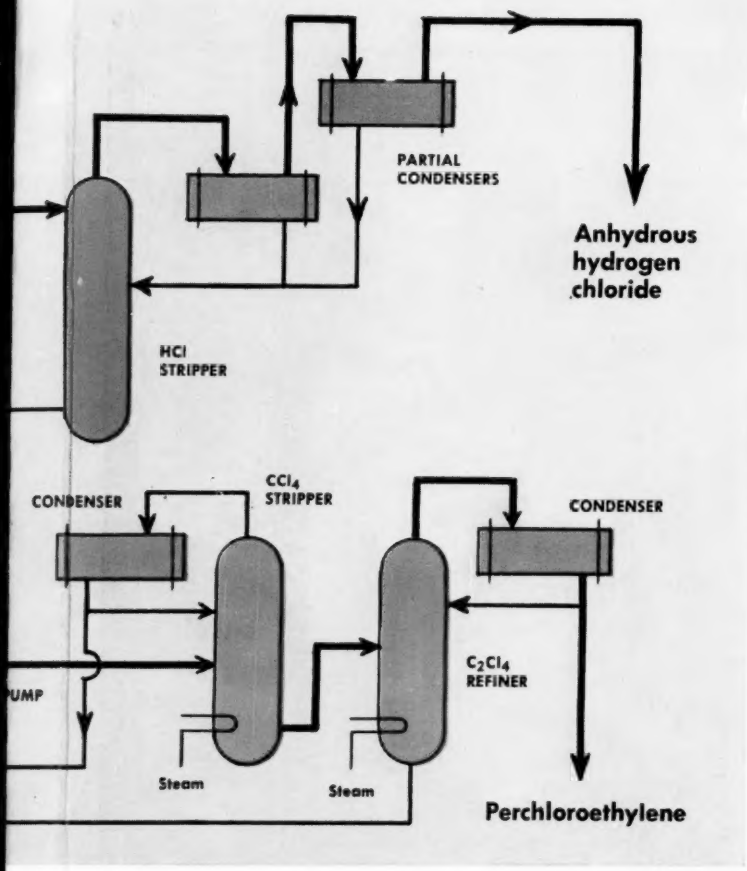
Light hydrocarbon starting material (e.g., methane, propane, propylene) in SD process may cost as little as 25% of acetylene feed.

Hydrogen chloride forms an integral part of process economics; for every pound of perchlor formed, more than 1 lb. of HCl is also produced. For production operations requiring HCl, perchlor unit can be tailored to fit right into production scheme. Pechiney, for example, pipes plastic-grade HCl gas over the fence to its own vinyl chloride unit.

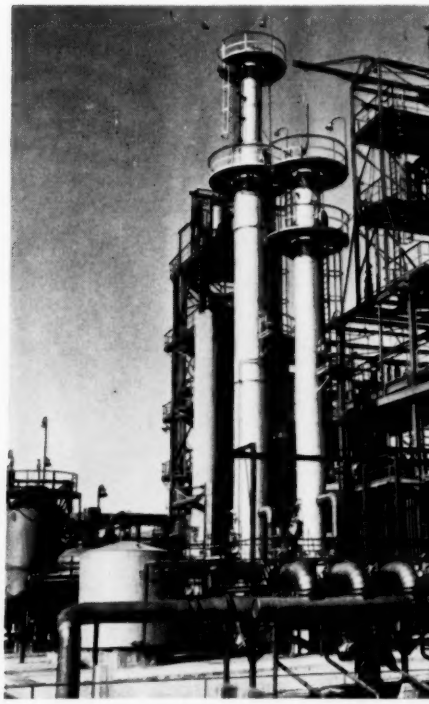
Process yields are close to theoretical. One plant was designed to give 20 pounds of perchlor and 27 pounds of HCl from a feed consisting of 45 pounds of chlorine and 4 pounds of propane.

▶ **Need Tough Materials**—Characteristic of process are the severe corrosion conditions created by handling HCl and chlorocarbons at temperatures up to 1,200 F.

Pechiney plant makes extensive use of nonmetallic inorganic materials to thwart corrosion. Equipment in HCl service features impervious graphite and ceramic construction. In other services, corrosion-resistant alloys, glass and plastics find many applications. Special fabrication techniques are



PECHINEY'S compact perchlor plant at St. has capacity rated at upwards of 20 million



required in chlorination furnace and quench vessel since they pose especially stringent mechanical design problems.

▶**Process Runthrough** — Here's how the SD process operates at the Pechiney plant:

Chlorine gas, hydrocarbon feed and recycle streams are fed to chlorination furnace operating at 900-1,200 F. At this temperature, chlorination proceeds spontaneously; no catalyst is needed. Heat of reaction maintains operating temperature.

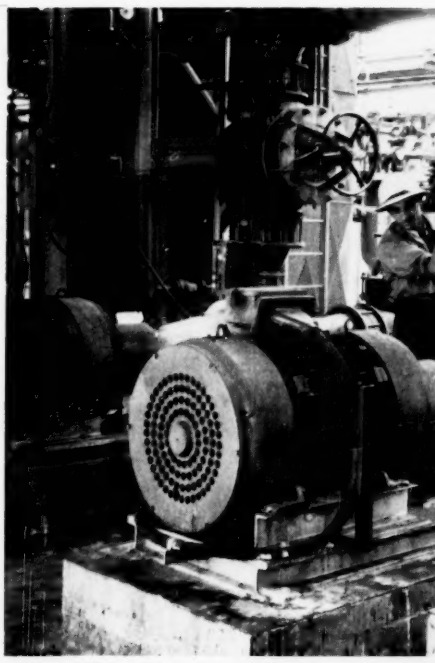
Exit gases are quenched in aqueous HCl, cooled to 140 F. and separate into an aqueous and organic layer. Bottom layer, consisting of perchloroethylene, carbon tetrachloride, some HCl and Cl_2, is stripped in a blowback column. Mixed chlorocarbon bottoms are pumped to a carbon tet stripper and carbon tet recycled to reaction furnace.

Impure perchlor bottoms are purified in a second fractionating tower, giving a perchlor overhead containing only parts per million of impurities. Residue is recycled to furnace.

▶**Byproduct Recovery** — Unquenched gases from quench vessel and part of aqueous layer from hold drum pass to an HCl absorber where part of HCl is absorbed in weak acid. Bottoms serve as quench medium.

Remainder of aqueous layer is partially stripped to remove traces of dissolved chlorine and passes to an HCl stripper that gives an anhydrous HCl overhead product. Weak acid bottoms, close to azeotropic concentration (roughly 20% HCl), is pumped to HCl absorber.

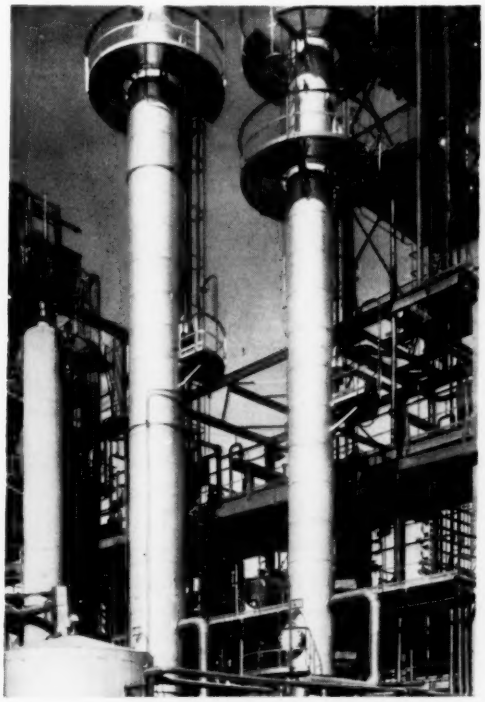
Gases passing through HCl absorber are compressed in a recycle blower, partially condensed, and passed through a knockdown column. Chlorine overhead is recycled.



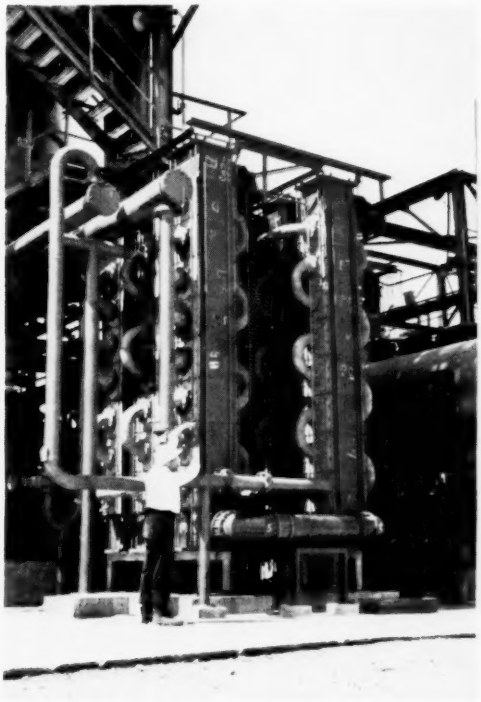
CIRCULATING PUMPS and piping in HCl ceramic linings and impervious graphite materi

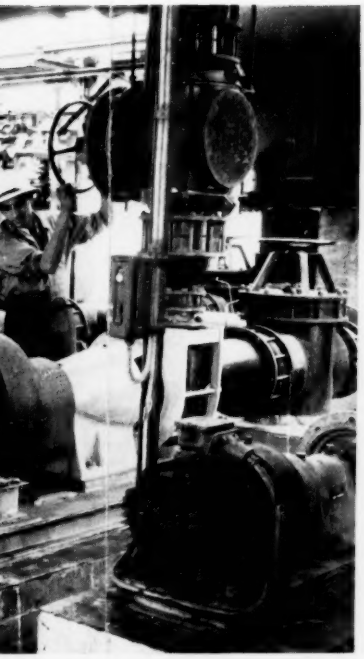
t St. Auban
llion lb./yr.

COLUMNS, HCl stripper at left, carbon tet stripper in the center and perchlor refiner at the right.

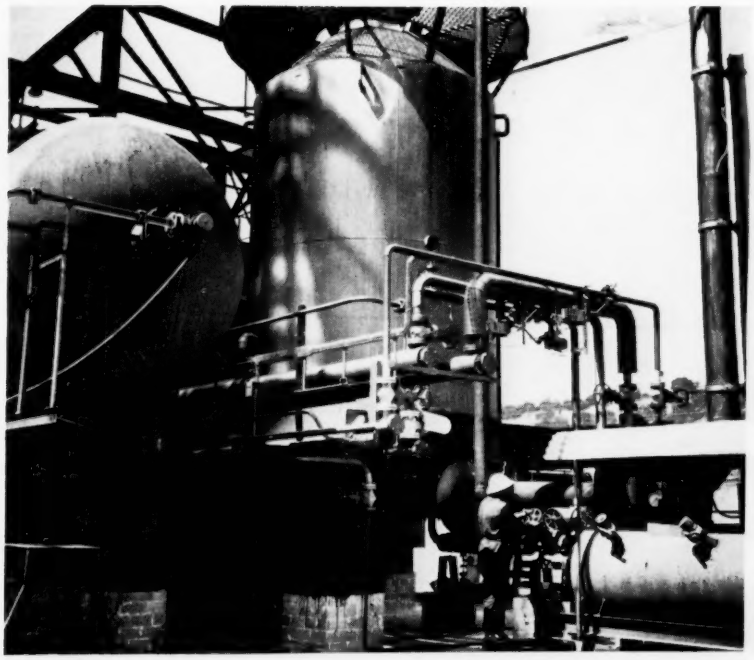


COOLERS, fabricated from impervious graphite blocks, cycle dilute HCl back to quench vessel.

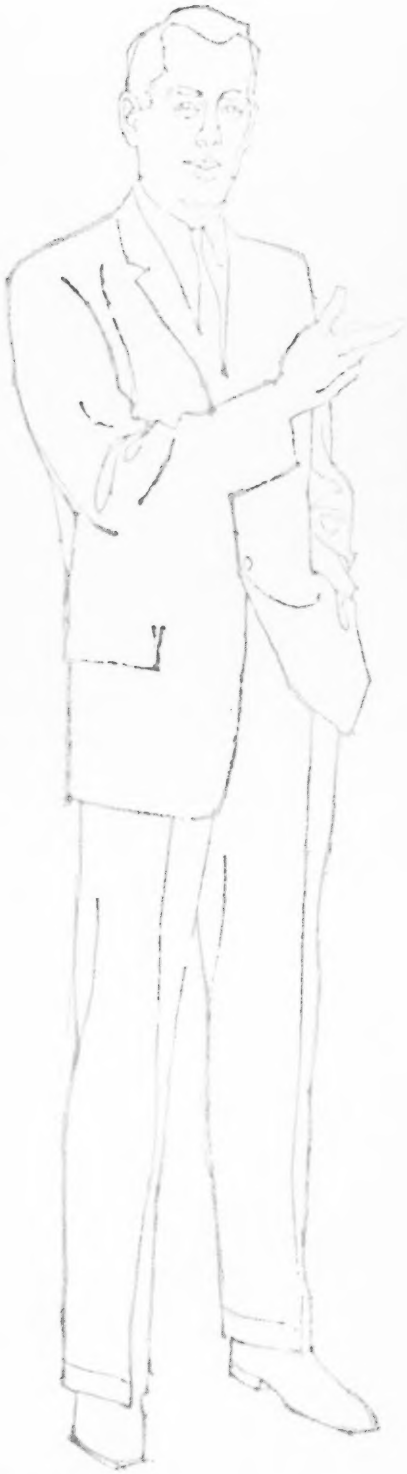




HCl service require extensive use of
naterials of construction.



CHLORINATION FURNACE, operating at around 1,000 F., poses severe corrosion problems that were licked with nonmetallic inorganic furnace linings.



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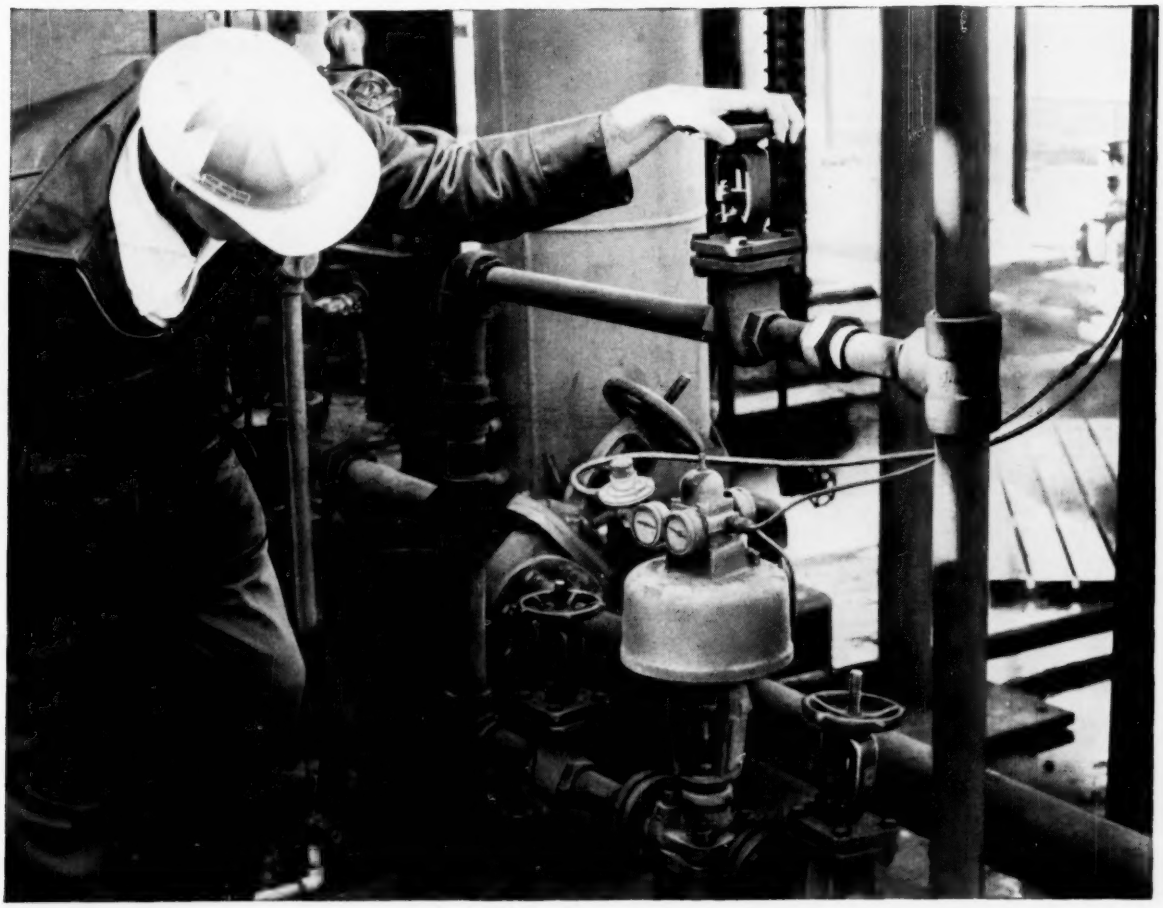

"Craneloy 20" valves on sulphuric service outlast valves formerly used 6 to 1

Handling sulphuric acid in varying concentrations is tough service for any valve.

At this Texas City, Texas, refinery, valves used on lines from sour water strippers never lasted more than 6 months. It was a case of "install today . . . replace tomorrow."

Three years ago, "Craneloy 20" gates were selected for this service. These high-nickel, high-chromium stainless valves, with rotating split-wedge disc seating, have given trouble-free service ever since. No leakage, no galling or seizing; and always operating smoothly.

To date, "Craneloy 20" valves have outlasted the other make valves 6 to 1—better than a 500% saving in replacement and maintenance cost.

If you're having trouble with valves on sulphuric acid or similar corrosive fluids, your Crane Representative has all the information on the "Craneloy 20" line.

Bring yourself up to date on corrosion-resistant alloy valves. Send for this Crane Circular AD-2080 today.

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with Flash Drying
for fine grinding

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with Flash Drying
for fine grinding

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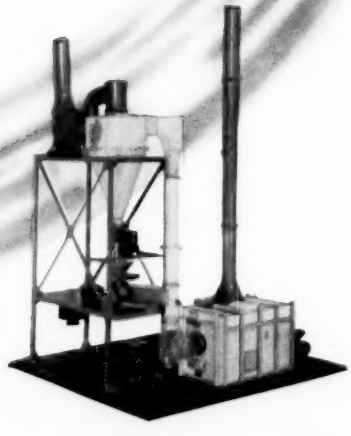
for disintegrating



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It offers new economies in the manufacture of fine chemicals, pigments, synthetic resins, hydrated compounds, filter cakes, food products, gypsum and clays.

Combines in one integrated system the functions often performed by several different units.
Uses minimum building space for a given capacity.
Provides accurate control of final moisture content in the finished material.
Minimum attention and operating labor with continuous automatic operation.
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Chemical Engineering

Practice

MAY 5, 1958

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For really clean air in and around your plant..... 139

The dust and fumes which puff out of most chemical plants create a dirty, smelly, and—often—harmful atmosphere. Here's what to keep in mind for effective pollution control.

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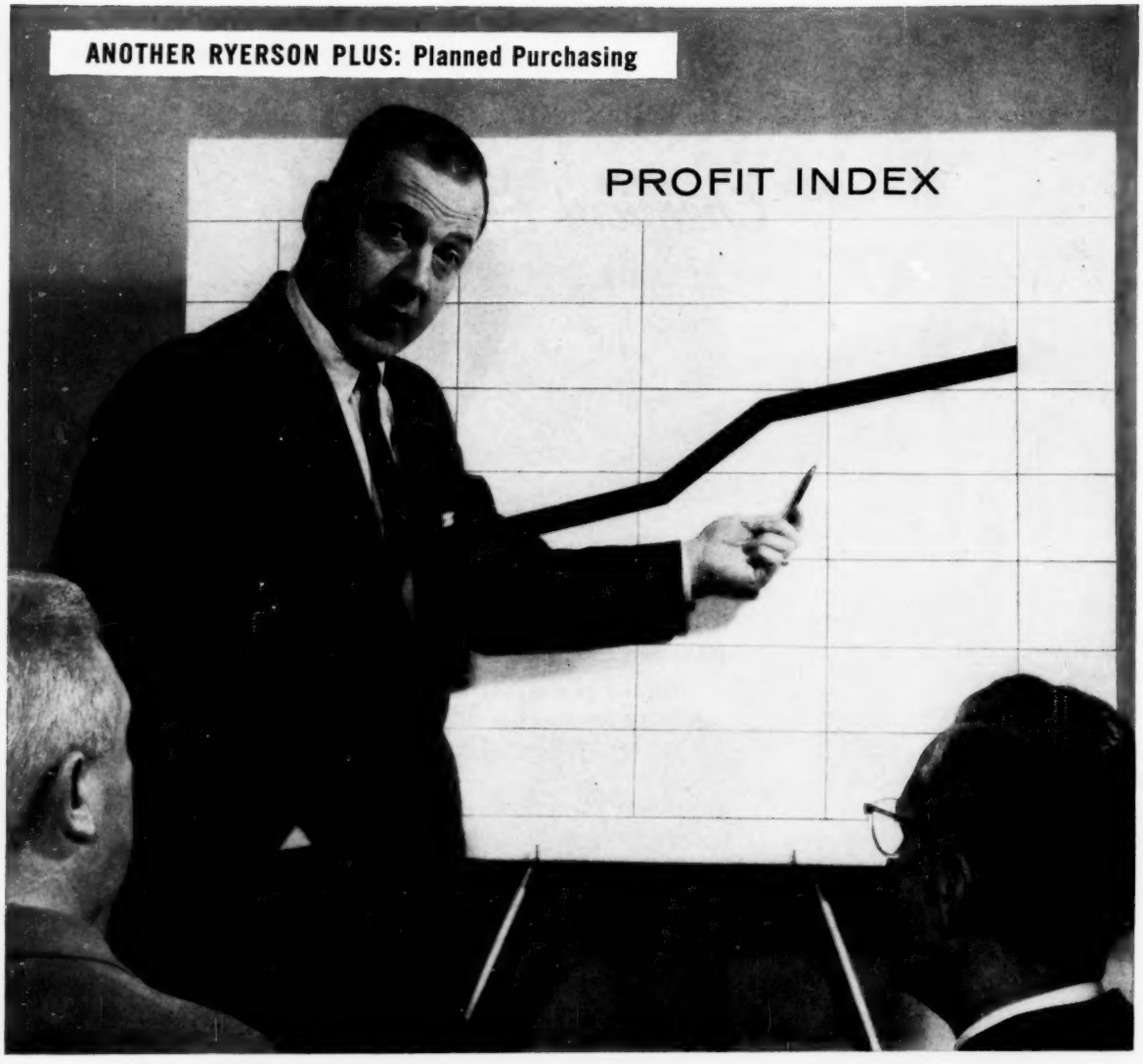
Here are methods that will help you approximate the temperature dependence of surface tension and the variation caused by composition changes in mixtures.

Plastic panels earn approving nod from CPI builders.. 152

Chemical plant builders are looking into translucent reinforced plastic panels which snub chemical attack and corrosion; offer high strength and low cost, too.



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Chemical Engineering
MAY 5, 1958

New Processes and Technology

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HERE'S your guide to significant technical developments in the chemical process industries for the period starting with July 1956. Almost 300 listings are included in this eighth CE process inventory, each item condensed to its factual core. Carefully screened to put you on top of latest developments, our selective directory covers only projects that have been made public and that have reached an advanced stage of development.

• Ceramics & Cement

Product	Process	User	Features	Remarks
Cement	Pipe-coil preheater	Coplay Cement Mfg. Co. Coplay, Pa.	Dry feed is pneumatically pumped through pipe coil into rotary kiln. Hot gases from kiln flow outside coil; heat is transferred through pipe wall to kiln feed.	Grudex preheater, made by Kennedy-Van Saun, reduces fuel consumption, increases kiln output.
Cement	Moving-grate preheater	Marquette Cement Mfg. Co. Milwaukee, Wis. Diamond Portland Cement Co. Middle Branch, Ohio	Raw materials are pelletized, fed to moving grate on way to rotary kiln. Hot, dust-laden exit gases from kiln make two passes through pellets, drying and preheating them.	Engineered in U.S. by Allis-Chalmers, ACL process saves on fuel, space and dust losses.
Cement	Fluid bed	Fuller Co. Catasauqua, Pa.	Powdered raw materials are reacted in fluid bed instead of conventional kiln. Clinker formed is more uniform and has less free lime than kiln cement.	First pilot stage is completed. Larger unit will investigate commercial possibilities.
Cement clinker	Traveling-grate stoker	Trulite Corp. Caredo, W. Va.	Coal refuse reclaimed from coal-washing operations is ground, pelletized, then burned at 2 500 F. on traveling-grate stoker. Clinker is ground and sized.	Lightweight clinker finds use in manufacture of cement blocks that show high strength.
Ceramic coatings	Flame ceramics	Continental Coatings Corp. of Chicago Chicago, Ill.	Ceramic powders, such as zirconia or alumina, spray through oxyhydrogen flame onto precleaned part being coated.	Process, developed by Armour Research Foundation, imparts abrasion and heat resistance.
Ceramic coatings	Low-temperature	Ervite Corp. Erie, Pa.	Ground-coated metallic panels are fired at 1,300 F., then sprayed with color cover coat to thickness of 3 mils. Refiring at 1,300 F. completes process.	Process was developed by Westinghouse for use on electric toaster housings.
Concrete, chemically resistant	Ocrate	Oerietfabriek, N. V. Baarn, Holland	Treatment of concrete with silicon tetrafluoride during curing step produces product with substantial quantities of calcium fluoride surrounded by silicon dioxide deposits.	Material thus formed makes concrete extremely resistant to corrosion.
Cubic boron nitride	High-pressure	General Electric Co. Schenectady, N. Y.	Product, dubbed borazon by its makers, is produced under superpressure, supertemperature conditions in a hydraulic press. Comparing with diamond in hardness, it can withstand more than 3,500 F.	In lapping tests, borazon polished away a diamond surface at the same rate as diamond powder.
Pyroceram	Nucleation heat treatment	Corning Glass Works Corning, N. Y.	One or more nucleating agents, added to a special glass batch, causes microscopic crystals to precipitate when glass products molded from batch are heat treated. More than 400 types have been experimentally made.	Ceramics made are harder than steel, lighter than aluminum, and nine times stronger than plate glass.
Silicon carbide refractory	Nitriding	Carborundum Co. Perth Amboy, N. J.	Mixture of silicon and silicon carbide, preformed to desired shape, is heated to high temperature in nitrogen atmosphere. Nitrogen reacts with silicon to form silicon nitride bond between carbide grains.	Product, trade-marked Refrax, was originally destined for Nike rocket nozzles.

Ceramics & Cement (cont.)

Product	Process	User	Features	Remarks
Structural blocks (gas concrete)	Hydrogen evolution	United States Durox Co. Englewood, Colo. Washington Ytong Corp. Tacoma, Wash.	Powdered aluminum, added to sand, lime and water mixture, reacts with calcium hydroxide to generate hydrogen bubbles within the mass. "Leavened dough" is allowed to set into a stiff cellular mud. Cutting, followed by steam curing, produces strong, lightweight structural building blocks.	Both concerns plan to double or triple their output in the near future.
Synthetic mica	Electric arc	Synthetic Mica Corp. Caldwell Township, N. J.	Mixture of silica sand, alumina and magnesia (calcined), potassium silicofluoride and feldspar is heated to about 1 350 C. in electric-arc furnace. Melt is cooled at rate of 1 deg./hr.	U.S. Bureau of Mines developed process; originally piloted in Germany.

• Fine Organic Chemicals

Product	Process	User	Features	Remarks
Amino acids	Via hydantoin	Dow Chemical Co.	Ammonium bicarbonate and sodium cyanide react with an aldehyde to yield a hydantoin. Hydrolysis of the hydantoin, followed by neutralization with ion exchange resin, gives pure acid.	Dow's pilot plant is expected to turn out 18 different amino acids.
Carbohydrate-aromatic compounds	Condensation		A carbohydrate (any of several) and an aromatic petroleum derivative contact anhydrous hydrogen fluoride catalyst in autoclave. After fluoride removal, extraction purifies the condensation product. Products may eventually find application as intermediates for detergents, pharmaceuticals, resins, etc.	Basic development work underway at Universal Oil products, Des Plaines, Ill. and Corn Products Refining Co., at Argo, Ill.
Cyclohexadiene dicarboxylic acids	Electrolytic reduction	California Research Corp. Richmond, Cal.	Phthalic acid is continuously reduced in mercury-cathode electrolytic cell. Process boasts high efficiencies and yields.	Now on bench scale, process shows promise for reduction of other organic compounds.
Dialkyl phosphites	Autothermic	Monsanto Chemical Co. Anniston, Ala.	Phosphorus trichloride and an alcohol are reacted in spray noxzle, cooled, stripped of low-boiling by-products. Reaction temperature is allowed to seek its own value.	Organophosphorus compounds have commercial value as insecticides, flame retardants and plasticizers. Bench scale.
Diaminoalkene	From dimethyl amine	Lakeside Laboratories Milwaukee, Wis.	Reaction of dimethyl amine with propargyl bromide yields propargyl amine. Treatment of amine with sodamide in toluene gives a derivative which splits on reaction with a halogen-substituted amine. Product is diaminoalkene.	Diaminoalkene is gateway to alkenes, alkanes, ketones, etc. Process, now in research stage, proceeds best at atmospheric pressure and 230 F.
Diethyl m-toluamide	From toluic acid	Hercules Powder Co. Brunswick, Ga.	Purified toluic acid and diethyl amine are raw materials. Details of reaction and purification steps are unknown.	Plant turns out drum quantities of this insect repellent.
Enzymes	Fermentation	Takamine Laboratory Clifton N. J.	Cornsteep or wheat bran media is cooked with dilute HCl and sterilized with steam, then cooled. Microbial spores are introduced and mash is fermented. Thickening or precipitation and drying complete the preparation.	Experts say enzymes will soon reach $100-million sales.
Glutamic acid	Fermentation	Kyowa Fermentation Industry Co. Hofu, Japan	Starting with sweet potatoes, a culture broth containing nitrogen sources and inorganic material is made. Mixture is maintained at pH 6–9 and biotin added to maintain balance between propagation of microorganisms and fermentation.	Plant makes 2.4 million lb./yr. Yields are said to be high.
Hexamine	Crystallization	Various Europe	Gaseous formaldehyde, from an integrated methanol oxidizer, and ammonia vapor are absorbed and reacted in hexamine mother liquor. Heat of reaction concentrates solution by boiling to form a slurry of hexamine crystals. Slurry is filtered to remove product and the filtrate returns as mother liquor.	This new process, developed by the firm of Josef Meissner, is undergoing close scrutiny by two American firms. Two European plants now in operation.
Lysine	Fermentation	Chas. Pfizer & Co. Brooklyn, N. Y.	Corn-steep liquor, glycerine and a mutant strain of *E. coli* are fermented in presence of air. Then a wild strain of *E. coli* is added and ruptured with toluene to produce enzymes; reacts with broth to yield lysine. Recovery consists of filtration, ion exchange, decolorization and crystallization.	Lysine, an amino acid, is one most lacking in wheat products. Other firms use extraction and chemical synthesis to produce it.
Methyl butynol	Ethynylation	Air Reduction Chemical Co. Calvert City, Ky.	Reaction of acetylene and acetone over basic catalyst gives methyl butynol, also some pentynol.	Capacity is 3 million lb./yr.
Neopentyl glycol	Condensation	Texas Eastman Co. Longview, Tex.	Isobutyraldehyde and formaldehyde are condensed. Hydrogenation of condensation product yeilds neopentyl glycol.	Plant producing several million lb./yr. is in operation.
Niacin	Sulfonation	Koppers Co. Arroyo, W. Va. (Others)	Coal-tar quinoline is sulfonated with sulfuric acid to yield quinoline-8-sulfonic acid. Oxidation of this stream with nitric acid yields raw niacin.	Koppers' plant now turns out 500,000 lb./yr. Merck uses 2-methyl 5-ethyl pyridine instead of quinoline.
Phytic acid	Ion exchange	A. E. Staley Mfg. Co. Decatur, Ill.	Treatment of corn steep liquor of 20–25% solids content with calcium hydroxide gives crude calcium phytate. This is dissolved in HCl, reprecipitated with lime, and solubilized with recycle phytic acid. Ion exchange resins remove calcium ions.	Chief commercial use is based on its rust-inhibiting action.
Proteins	Anion exchange		Using one of a family of new cellulose-derived ion exchange adsorbents, diethyl aminoethyl (DEAE) cellulose, researchers have found way to separate protein fractions without denaturation.	Cellulose derivatives available from Brown Co., Berlin, N. H.
Pseudoionone	Partial hydrogenation	Hoffman-La Roche, Inc. Nutley, N. J.	Acetone and acetylene react in liquid ammonia to give methyl butanol. Partial hydrogenation over Lindlar catalyst produces dimethyl vinyl carbinol. Treatment with diketene, followed by pyrolysis, yields methyl heptenone. Repeating the process, starting with methyl heptenone, gives product.	Pseudoionone is a Vitamin A intermediate.

Fine Organics (cont.)

Product	Process	User	Features	Remarks
Reserpine	Extraction	CIBA Pharmaceutical Products Summit, N. J.	Reserpine tars are leached from chopped Rauwolfia roots with methanol, then concentrated by evaporation. Extraction with ethylene dichloride, followed by cleanup and drying, completes process.	CIBA turns out about 1 ton/yr. of the tranquilizer.
Terpenes	Ethynylation	Hoffman-LaRoche, Inc. Nutley, N. J.	Ketone feed stock undergoes ethynylation, hydrogenation, then condensation with diketene to form a methyl ketone. Diketene is prepared as needed by cracking acetone, followed by dimerization.	Acetone can be pyramided to vitamins and perfumes in this process.
Tetracycline	Fermentation	Lederle Laboratories Pearl River, N. Y. Chas. Pfizer & Co. Brooklyn. N. Y. Bristol Laboratories Schenectady, N. Y.	Bristol produces tetracycline directly in fermentation step, then recovers it from the mash. Lederle and Pfizer make aureomycin (chlortetracycline), then recover it and dechlorinate.	About 200,000 lb. of tetracycline was produced in 1956.
Wood sugars	Solvent extraction	.....	Extraction of spray-dried spent-liquor solids with acetone produces di-O-isopropylidene sugar derivatives. These are separated to individual sugars via steam distillation, chloroform extraction and acid hydrolysis.	Pilot-plant stage nearing at Sulphite Pulp Manufacturers' Research League, Appleton, Wis.

• Heavy Organic Chemicals

Product	Process	User	Features	Remarks
Acetic acid	Continuous evaporation	Norwich Pharmacal Co. Norwich, N. Y.	Black sludge from a nitration process is treated with nitric acid, heated and flashed into evaporation chamber. About 95% of acetic acid content vaporizes, gum-free acid condenses.	Unit recovers 5,000 gal./mo. o 99% acetic acid, prevents pollution of nearby streams.
Azobenzene	Carbon monoxide reduction	.....	Nitrobenzene is reduced by carbon monoxide at 300 atm. and 425 C. in presence of gamma-aluminum oxide catalyst. Water must be excluded to prevent side reactions.	Developed in Germany; should produce azobenzene for 51¢/kg. in 40-ton/mo. plant.
Benzene	Hydrogen refining	Newton Chambers & Co. Thorncliffe, England	Crude coke-oven benzene and hydrogen streams are combined and heated to vaporize the benzene. Removal of wash oils by scrubbing, followed by further heating, prepares stream for catalytic hydrogenation of contaminants.	Current work indicates process is suited to naphtha with only minor revisions.
Benzene, toluene and xylene	Hydrogen refining	Jones & Laughlin Steel Corp. Aliquippa, Pa. U. S. Steel Corp. Clairton. Pa.	Hydrogenation converts sulfur in coke-oven light oils to H_2S, and hydrogenates unsaturates. After H_2S removal, glycol solvent extracts any BTX. Distillation recovers BTX from glycol.	Commercial. J&L uses Esso process, USS uses Koppers process.
Butadiene	Extractive distillation	Shell Chemical Corp. Torrance, Cal.	Substitution of acetonitrile for acetone as extractive distillation solvent increases butadiene capacity from 2,100 to 3,000 bbl./day.	U.S. Government owned Torrance plant until early 1955.
Carbon monoxide	Steam reforming	Various	Steam reforming of natural gas, removal of CO_2 by absorption in an amine, caustic scrubbing, and low-temperature fractionation are process steps leading to pure carbon monoxide.	Hydrogen is a byproduct of the process. Users include National Aniline, DuPont, Mobay and Rohm & Haas.
Char	Medium-temperature carbonization	Koal Krudes Red Lodge, Mont.	Bituminous coal is continuously charred in six retorts at around 1,200 F.; produces high-carbon char plus distillation products.	Plant is swinging into commercial production. Input: 320 tons/-day coal.
Coal, atomized	By nuclear radiation	Denver & Rio Grande Western Railroad	Coal particles, 200 mesh in size, are shattered into 1-micron particles by gamma irradiation from nuclear wastes.	Incorporation of powdered coal into diesel fuels is the ultimate goal.
Coal, dry	Fluidized-bed drying	Lynville Coal Co. Lynville, Ind.	Pulverized coal, ignited in lower section of fluid-bed reactor, provides heat for drying rest of coal blown through on 22,000-cfm. air stream.	Unit has handled from 60–107 tons/hr.
Coke-oven gas	Perox	Mulheim-Meiderich Iron Works Germany	Sulfur is removed from gas by washing with mildly ammoniacal solution. Treating wash with hydroquinone recovers elemental sulfur.	Claims lower costs than Thylox process and potash method.
Dimethyl hydrazine, unsymmetrical	From natural gas	.....	Hydrazine can be made from salt, air and natural gas. Details unknown, but developers say process will make this rocket fuel for $30/gal.	Developed by University of Florida, sponsored by Davison Chemical Co.
Formaldehyde	Modified Fischer	Borden Co. Fayetteville, N. C. Kent, Wash.	Oxidation-dehydrogenation of methanol over special silver catalyst in vertical converters yields raw formaldehyde. Absorption, distillation and ion exchange steps clean up product.	Borden holds exclusive U.S. sublicense rights to process.
Fuel gas	Fuel gasification	.....	Pulverized coal is introduced into steam carrier. Series of cyclonizers reduces particle size; reacting with oxygen gasifies carbonaceous material. Gas can be methanized to up heat content.	Gasification step has been piloted by Institute of Gas Technology. Works with any coal.
Gelatin	Low-temperature drying	American Agricultural Chemical Co. Detroit, Mich.	Pig gelatin from a reactor, extruded into noodles, is passed through dryer on perforated conveyor belt. Dehumidified air at 85 F. dries product.	Unit uses less than 10% of air required for forced-air tunnel dryers.
Glycerine	Fermentation	Imperial Chemical Industries, Ltd. Glasgow, Scotland	Controlled fermentation of molasses to produce glycerine, acetaldehyde and alcohol is in pilot-plant stage. Recovery steps include steam stripping, evaporation, extraction and distillation.	Process licensed by Imperial through Scientific Design Co., New York.
Methanol	Inventa	Hercules Powder Co. Louisiana, Mo.	Synthesis gas from reforming furnace is compressed and converted to methanol in a catalytic converter at 350 C. Process success lies in new catalyst which gives 92–93% conversion and which has a long life—about 18 mo.	Producing 70 tons/day; process licensed in U.S. by Vulcan Cincinnati.
Methyl styrene	Alkylation	American Cyanamid Co. Avondale, La.	Alkylation of toluene with acetylene in presence of mercuric sulfate (in 95% H_2SO_4) catalyst yields ditolyl ethane. DTE is stripped from reaction mass, mixed with steam and cracked over clay catalyst to methyl styrene and toluene.	Toughest problem that Cyanamid must deal with in its 40-million-lb./yr. plant is mercury confinement and recovery.

Heavy Organics (cont.)

Product	Process	User	Features	Remarks
Naphthalene	Hydrogenation		Methyl naphthalene and hydrogen are heated to 900–1,200 F. and passed through silica-alumina cracOking catalyst; yields 70% naphthalene.	Several oil companies are investigating.
Nitroglycerine	Continuous	Nitroglycerine Aktiebolaget Sweden	Glycol-glycerol feed is mixed with acid in injection system. Two phases flow to centrifugal separator, water injector removes explosive effluent.	Automatic nitration gives high degree of control and safety. Yields are around 94%.
Oil, clarified	Continuous percolation	Minerals and Chemicals Corp. of America Menlo Park, N. J.	Adsorbent feeds continuously to top of cylindrical reactor, falls by gravity and contacts rising oil fed from bottom. Screw-type elevator removes adsorbent from bottom; clarified oil is drawn off top.	Reduces high capital cost of static-bed construction.
Phthalic acid	Catalytic oxidation		Key is probably a bromine-activated metal catalyst. Xylenes are oxidized to phthalic acids or anhydrides in one-step, liquid-phase process.	Purchased by Standard of Indiana for a proposed 60 million-lb./yr. plant.
Silicones	Silanes hydrolysis	General Electric Co. Waterford, N. Y.	Silicon metal, in presence of copper catalyst, reacts with methyl chloride to produce gas mixture of methyl chlorosilanes. Hydrolysis of silanes, followed by distillation, gives variety of silicone polymers.	Silanes can be converted into over 450 different silicone products.
Styrene	Fractionation	Cosden Petroleum Corp. Big Spring, Tex.	Mixed xylenes feed into three-section distillation tower having 350 plates in 600 ft. of total height. The 30% ethyl benzene in feed comes off tower with 99+% purity. Catalytic dehydrogenation of ethyl benzene yields raw product.	Plant makes more than 20 million lb./yr. of plastic-grade styrene.
Sugar	Ion exclusion	Illinois Water Treatment Co. Rockford, Ill.	Treating blackstrap molasses with lime and phosphoric acid, followed by centrifuging, yields clarified mixture free of suspended impurities. Ion exclusion removes 90% of soluble mineral salts. Syrup then returns to crystallization process.	Ultra-Sucro Co. developed process.
Synthesis gas	Anthracite gasification	Philadelphia & Reading Co.	Finely powdered anthracite used directly; side-steps problems of caking and clinkering.	Semi-commercial unit planned.
Terephthalic acid	Henkel	Hercules Powder Co. Wilmington, Del.	Alkali metal benzoate is heated, then catalytically converted in inert atmosphere to metallic salt of terephthalic acid; this salt is sprung to the free acid.	Pilot plant stage.
Tetraethyl lead	Electrolytic	Ethyl Corp	Ziegler polymerization catalyst, triethyl aluminum, incorporated into a complex sodium fluoride salt, is electrolyte of the cell. Electrodes are lead. TEL forms at anode and collects at bottom of the cell.	Process is still in bench-scale phase. A byproduct is 99.99% pure aluminum.
Trimethylol propane	Aldol condensation	Celanese Corp. of America Bishop, Tex.	Reaction of formaldehyde with butyraldehyde, in presence of an alkaline catalyst, yields TMP. Distillation rounds out a series of purification steps.	Final water level is below 0.05%. Plant's capacity is 10 million lb./yr.
Urea	Inventa	Standard Oil Co. (Ohio) Lima Ohio	Liquid ammonia and carbon dioxide react at 3,000 psi. and 375 F. to form ammonium carbamate. Carbamate decomposes to urea and water.	Process is noted for its low maintenance, high yield, and relatively high-purity products

• Inorganic Chemicals

Product	Process	User	Features	Remarks
Ammonia synthesis gas	Fuel oil gasification	Shell Petroleum Co. Shell Haven, Eng.	Feedstock ranging from gaseous hydrocarbons to heavy fuel oil is converted to crude synthesis gas via partial burning under pressure with oxygen or enriched air.	$17-million plant on stream
Bromine	NaBr absorption	Dead Sea Bromine Co. Sodom, Israe	Clarified magnesium bromide brine is chlorinated and swept with air. Bromine-rich air stream is dechlorinated by an incoming brine drag stream, then absorbed by pure aqueous sodium bromide to produce polybromides. These decompose on heating to give product.	In operation since Dec. 1956, plant produces 1,250 tons/yr. of high-purity bromine. Capacity will be raised in near future.
Calcium oxide	Lime sludge recovery	City of Lansing, Mich.	Fluid-bed calcination of 500-mesh calcium carbonate sludge produces pellets (20 mesh) if small amount of soda ash is added to 1,700 F. furnace compartment.	Pelletization reduces elutriation and permits higher gas velocities. Developed by Dorr-Oliver.
Carbon products	Resistance baking	National Carbon Co. Lawrenceburg, Tenn.	Electric current is passed through green carbon product to give it a quick cure while in hydraulic press.	Said to shorten curing time from eight weeks to eight minutes.
Catalysts	From sodium hydride	Metal Hydrides, Inc. Beverly, Mass.	Sodium hydride particles dispersed in mineral oil react with titanium or aluminum chlorides. Addition of ethylene to the reactor completes conversion.	Catalysts are used for ethylene polymerization.
Chromyl chloride	Chlorination	Mutual Chemical Co. Baltimore, Md.	Chromyl chloride acts as reaction medium for chromic anhydride chlorination with HCl. This eliminates undesirable side reactions and gives 98% yield.	In ton-lot production.
Chlorine	Absorption	Diamond Alkali Co. Muscle Shoals, Ala. Edgewood, Md. Deer Park, Tex.	Stream containing chlorine to be recovered contacts carbon tetrachloride in packed tower under pressure. Stripping and cooling yields liquid chlorine.	Diamond is planning to license process.
Chlorine	Absorption	Hooker Electrochemical Co. Montague, Mich. Tacoma, Wash.	Sniff gas from chlorine-liquefaction processes (containing 30–40% chlorine) is absorbed in water destined for direct-contact cooling of hot cell gas.	Process requires small capital investment, most of which goes for packed tower.
Chlorine	From HCl	Oronzio de Nora Impianti Elettrochimici Milan, Italy	Waste hydrochloric acid is electrolyzed in filter-press-type cell. 36-cell unit operates at 1,000 amp. and produces 1 metric ton/day chlorine.	Unit recovers valuable byproduct and solves waste-acid disposal problem.
Chlorine dioxide	Reduction	Columbia-Southern Chemical Corp.	Sodium chlorate is reduced by trivalent chromium to give chlorine dioxide and dichromate. Dichromate reduces back to trivalent chromium on treatment with sulfur dioxide.	Crystallization removes by-product sodium sulfate from recycle liquor.
Chlorine dioxide	Sodium chlorate reduction	Olin Mathieson Chemical Corp.	One mole of sodium chloride per 10 moles sodium chlorate, added to feed, ups ClO_2 yield to about 97%, cuts Cl_2 output to around 1.5%.	Process improvement is easily adapted to present ClO_2 installations.
Decaborane	Pyrolysis	American Potash & Chemical Corp. Henderson, Nev.	Process utilizes trichloride intermediate, which is pyrolyzed to form a mixture of pentaborane and decaborane.	Pilot unit produces about 1 lb./day of decaborane.

Inorganics (cont.)

Product	Process	User	Features	Remarks
Graphite, reactor-grade	High-temperature	Graphitwerke Kropfmuehl Germany	A mineral containing 20% graphite as crystal flakes is concentrated by flotation. Graphite is processed by undisclosed high-temperature method, powder is pressed at 3,000 atm.	In production, producing block graphite with density of 2.07 gm./cc.
Hydrazine, anhydrous	High-frequency	Lord Mfg. Co. Erie, Pa.	Ammonia is passed through radio-frequency field of decreasing intensity at controlled pressure, temperature and residence time. High-energy activation produces a yield of hydrazine feasible for recovery.	Excellent for all gas-phase syntheses requiring high-activation energy at low temperatures. Process still on bench.
Hydrogen.....	Coal gasification	Hydrocarbon Research Trenton, N. J.	New pilot plant features 60-ft.-high reactor for hydrogen production by fluid-bed gasification of anthracite silt with steam and oxygen.	Philadelphia & Reading Corp. is financing project.
Hydrogen peroxide	Hydrogenation-oxidation	Allied Chemical & Dye Corp. Syracuse, N. Y.	Oxygen-containing complex organic material is catalytically hydrogenated, then oxidized, forming H_2O_2. Complex organic is recycled and H_2O_2 stripped out.	Organic might be 2-methyl anthraquinone. Commercial.
Manganese dioxide	Sodium chlorate reaction	American Potash & Chemical Corp. Henderson, Nev.	Manganese sulfate reacts with sodium chlorate at 200 F. in presence of sulfuric acid to form manganese dioxide. Product is rho-phase rather than the gamma crystal associated with electrolytic methods.	The rho-phase manganese dioxide is especially suited for battery use. Pilot plant stage.
Metal chlorides	Chlorination.....	Salem-Brosius, Inc. Carnegie, Pa.	Chromite, spodumene, zircon or other ores are swept along with coke breeze and chlorine through carbon reactor tube. Using tube as electrical resistor provides required heat.	Capacity of pilot plant is about 0.5 tons/day. About 90% of chlorine reacts.
Mineral salts....	Modified Frasch.	Intermountain Chemical Co. Sweetwater County, Wyo.	High-pressure injection of heated chemical stream at depth of 1,500 ft. dissolves trona, which then rises to the surface.	Working towards commercia scale.
Molybdic oxide	Sublimation.....	Climax Molybdenum Co. Langeloth, Pa.	Impure molybdic oxide is spread thinly on a rotating hearth beneath electrical heating elements. As pure oxide sublimes, air stream sweeps fume out of furnace to be cooled and collected.	Climax can now turn out an additional 3 million lb./yr. of high-purity oxide.
Nitric acid.....	Nuclear radiation	.....	Oxide of U-235, incorporated into glass fibers, provides fission energy for fixation of atmospheric nitrogen. Preferred operating conditions: Pressure, 150 psi. and higher; temperature, around 400 F.	Yields have been 5–15%. Developed at RPI, piloted at Brookhaven National Laboratory.
Nitrophosphates	Nitric acidulation	.....	Air strips ammonia from a 30%-ammonia byproduct liquor. The stream oxidizes to nitrogen oxides for nitric acid production. Process uses the acid to acidulate phosphate rock in presence of potash and additional ammonia.	Process proposed by Paul Caldwell, Chicago chemist.
Ozone.....	Adsorption.....	Linde Co.....	Ozone, 2% by volume in stream of oxygen, is produced by passing oxygen through an electrical discharge. Silica gel adsorbs ozone from mixture, nitrogen (or some other fluid) desorbs it.	Process undergoing pilot-plant development.
Phosphoric acid	St. Gobain.....	Northwest Nitro Chemical Ltd. Medicine Hat, Alta.	Single-stage ore digester for phosphoric acid production makes plant cheaper to build and operate.	Commercial plant handles about 410 tons/day phosphate rock.
Phosphate rock..	Calcination.....	San Francisco Chemical Co. Montpelier, Idaho	Carbon is burned out of phosphatic shale in fluid-bed calciner. Fuel value of the shale supports combustion.	Process engineered by Dorr-Oliver.
Potassium borohydride	Precipitation....	Metal Hydrides, Inc. Beverly, Mass.	Potassium hydroxide precipitates an aqueous, alcoholic solution of sodium borohydride. Potassium borohydride precipitate, recovered by filtration, dries in a steam oven.	Potassium borohydride is reducing agent used in syntheses of corticosteroids and Vitamin A.
Rare earths.....	Ion exchange....	Lindsay Chemical Co.... West Chicago, Ill.	HCl solutions of rare-earth oxides are contacted with Dowex 50 exchange resin in glass columns; gives rare-earth compounds up to 99.9% pure. Separation takes about 70 days to complete.	Charge per column is around 2,000 grams of rare-earth oxides.
Rubidium and cesium carbonates	Recovery.....	San Antonio Chemicals San Antonio, Tex.	End-liquor from lithium hydroxide plant undergoes filtration, granulation and dehydration to give a mixture of 70% potassium, 23% rubidium and 2% cesium carbonates.	Feed stock comes from American Lithium Chemical Co.
Sodium borohydride	From methyl borate	Metal Hydrides, Inc. Danvers, Mass.	Sodium hydride and methyl borate react to form sodium borohydride, releasing methanol. Methanol is recovered and reacted with boric acid to yield the borate reactant for main step.	Plant has rated capacity of several tons/day.
Sodium hydroxide	Electrolysis.....	Asahi Glass Co. Yodogawa, Japan	Purified brine feeds into vertical rotating-cathode cell. Cathodes rotate through mercury bath and carry mercury film into brine. Caustic is recovered from amalgam formed, and chlorine from depleted brine.	Capital costs are about 2.5 times that of conventional unit, but operating costs are lower. Plant turns out 20 tons/mo.
Sulfuric acid.....	From coke-oven gas	Concordia Bergbau AG. Oberhausen, Germany	Coke-oven gas is washed with NH_3, recovering 80% of H_2S in gas. H_2S is oxidized over vanadium catalyst, giving 99.2% yield of SO_3; condensation and pressure filtration give 99.9% pure sulfuric acid.	Company claims it can produce acid for $6.30/ton.
Sulfuric acid, recovered	From pickle liquor	Various Europe	Pickle liquor flashes into spray dryer, concentrating acid and ferrous sulfate. Further acid addition crystallizes out most of salt; gives acid with only 1–2% Fe.	Developed in West Germany, process is offered in U.S. by Koppers.
Sulfur dioxide...	Fluidized-bed burning	Commonwealth Fertilizers & Chemicals Melbourne, Australia	Sulfur ore feeds onto fluidized bed of sand. Enough air passes through bed to fluidize the sand, burn 10% of the sulfur and volatilize the rest for subsequent burning in combustion chamber.	Process developed for high-purity sulfur ores.
Water, desalted..	Solar distillation	City of San Diego, Calif.	Sun's radiation evaporates sea water contained in large saucer-shaped concrete basins. Vapor condenses on air-cooled cover glasses for collection.	Plans to set up a unit for 500 gal./day.
Zinc oxide.....	Oxidation.....	New Jersey Zinc Co. Palmerton, Pa.	Zinc ore and coal feed onto moving grate of special furnace. As ore passes through hot zone, zinc vaporizes and passes to combustion chamber where it is air-oxidized.	Special traveling-grate furnace was developed by N.J. Zinc engineers.
Zinc oxide.....	Oxidation.....	Northwest Refining & Chemical Co. Spokane, Wash.	Zinc sulfide ore concentrates undergo flash oxidation by air in stationary reverberatory furnace. Rapid segregation gives slag, metallic oxide and combustion gases.	Plant turns out 10 tons/day of product.

• Metals

Product	Process	User	Features	Remarks
Aluminum products	Powder compacting	Aluminum Co. of America	Fine, unalloyed aluminum powder, covered with coating of aluminum oxide, is compacted and worked into high-strength products. Can withstand 900 F.	Products are available in form of extrusions, forgings, sheet, foil, tube and wire.
Cobalt	Alkaline leaching	Metallurgical Resources, Inc. Newburgh, N. Y.	Cobalt ore is leached with sodium hydroxide under close temperature and pressure control. Impurities (arsenic and sulfur) dissolve, cobalt is recovered from residue.	A 10-ton/day facility is on stream.
Cobalt	Hydrogen reduction	Sherritt Gordon Mines Fort Saskatchewan Alta.	By careful reduction of a mixed Ni-Co solution, nickel-rich and then cobalt-rich coatings are formed on nickel seeds. Resulting solution is richer in cobalt than previously obtained.	Solution is quickly drawn off before stable equilibrium is restored. Commercial.
Ferromanganese	Electric-furnace smelting	Strategic-Udy Metallurgical & Chemical Processes, Ltd. Niagara Falls, Ont.	In first of three furnaces, molten ore is smelted with lime and coal. Upgraded manganese slag moves to second furnace, where it reduces to either high-carbon ferromanganese or ferromanganese-silicon. Third furnace turns out low-carbon FeMn.	Process is particularly valuable for processing low-grade ores. Commercial unit underway at New Brunswick site.
Gold plate	Atomex plating solution	Dodge, Inc. Newark, N. J.	Object to be plated is dipped into aqueous gold-complex solution. Plating results from galvanic interaction between base metal and complex ions. Plating stops as soon as an impervious, nonporous coating is formed.	Claimed to use 25–35% less gold for comparable quality plating. Process developed by Baker & Co.
Hafnium	Modified Kroll		Mixture of hafnium tetrachloride, sodium and magnesium is heated to about 730 C. and held there until all sodium reacts. Boosting temperature to 850 C. causes the magnesium reaction.	Dual reaction temperature results in less pickup of impurities. 40-lb. batch unit now operated by U.S. Bureau of Mines.
Iron	Hydrogen reduction	Alan Wood Steel Co. Ivy Rock, Pa.	Ore is reduced with hydrogen at 400 psi. and 900 F. in fluid bed; enables iron makers to bypass blast furnace.	Plans a 50-ton/day plant. Process, called H-iron, developed by Hydrocarbon Research Inc.
Iron	Methane reduction	Arthur D. Little, Inc. Cambridge, Mass.	Two streams, one methane and air, the other, 8-mesh iron ore, enter converter at opposite ends. Methane and some carbon monoxide and hydrogen, formed by cracking, reduce ore to iron and FeO.	Though not true sponge iron, product is excellent feed for open hearth. Process in pilot-plant stage.
Iron	Direct reduction	Republic Steel Corp. Birmingham, Ala. (National Lead Co.)	Reduction takes place in gas or oil-fired kiln, with countercurrent feed of ore, carbonaceous reducing agent and dolomite. Combustion control is key.	Republic's 175-ton/day pilot plant has successfully treated some 100,000 tons ore.
Iron	Continuous desulfurization		Caustic soda, reacting with sulfur in a moving stream of molten iron, continuously removes it with drawn slag. Stream of oxygen added to mixing chamber also removes silicon.	Process, still in lab stage, was developed by Battelle for Diamond Alkali; 90% of sulfur can be removed.
Iron	Methane reduction		Reduction of iron oxides with methane yields an iron concentrate and hydrogen. Magnetic separation completes the process. Extracts 90% of iron from ore.	Developed by Oil Institute of U.S.S.R. Academy of Sciences.
Manganese	Leaching		Low-grade iron-ore tailings, sulfuric acid and pyrite are heated, then reacted in presence of air. Clarified reaction product is recycled to attack fresh tailings until manganese content builds up. Then $MnSO_4$ is precipitated; later converted to metal by electrolysis.	Process, proposed by Canadian Department of Mines and Technical Surveys, is still in lab stage.
Manganese-bismuth	Melting	Westinghouse Electric Corp. Pittsburgh, Pa.	Manganese and bismuth are ground together under helium atmosphere. Heating the mixture to 520 F. yields the MnBi.	MnBi, ground to powder and molded in plastic, makes excellent magnets.
Metals, high-melting	Aluminum reduction		Oxides of metals such as titanium, zirconium, chromium, hafnium or vanadium are reduced with aluminum under conditions permitting complete removal of oxygen.	Developed by Illinois Institute of Technology, process yields high-purity metals.
Nickel	Electrolytic	International Nickel Co. Port Colborne, Ont.	Nickel is refined directly from nickel sulfide anodes; saves previous sintering and smelting steps.	Turns out 99.9% nickel on commercial basis.
Niobium	Cage-zone refining	Westinghouse Electric Corp.	Rectangular bar is moved through strong electric field. Metal melts radially from center, leaving corners to hold molten metal. Gives highest purity yet attained.	Used for laboratory studies.
Niobium	Solvent extraction		Recovers high-purity concentrate from Canadian pyrochlore; features HF-HNO_3 mixture for ore dissolution and methyl isobutyl ketone for tantalum-niobium extraction.	Proved on laboratory scale by Canada's Mineral Dressing & Process Metallurgy Div.
Rare metals	Solvent extraction	Colorado School of Mines Research Foundation Horizons, Inc. Cleveland, Ohio	Metal-pregnant aqueous solution is contacted with phosphate ester solvent in water-immiscible carrier. Metal ions migrate to organic phase. Steam stripping later removes solvent.	Metals processed include yttrium, thorium, vanadium, etc.
Rutile	From ilmenite		Ilmenite is heated to 500–1,000 C. in presence of carbon, pyrite and sulfur vapor. In 0.5–10 hr. ilmenite decomposes to rutile crystals and iron sulfide-oxide. Leaching with sulfuric acid at 20–110 C. removes iron compounds.	Patented by Commonwealth Scientific and Industrial Research Organization, Melbourne, Australia.
Silicon	Floating-zone refining	Bell Telephone Lab. Murray Hill, N. J.	A molten zone, supported only by surface tension, is repeatedly swept along a rod of impure silicon held rigidly at both ends. Motion of the molten zone carries impurities towards one end. Inductive heating, in a controlled, water-cooled atmosphere, produces the molten zone.	Impurity content of silicon refined by this method is below 1 ppb.
Silicon	Sodium reduction		Process for reducing silicon tetrachloride with sodium yields silicon with boron content of 2 ppb. Cost ranges from $250 to $350/lb.	Process has been used to make several thousand lb. of silicon in a foreign plant.
Steel	Cyclosteel reduction	British Iron & Steel Research Assn. London, England	Finely ground ore and coal are partially reacted in Fluo-Solids reactor. Partial-reduction products enter a cyclone-inducing slagging furnace where pulverized coal and oxygen complete the reduction.	Process, now in pilot-plant, may eliminate sintering, coking plants, blast furnace, pelletizing and fluxing.
Steel	Oxygen blowing	Gusstahlwerk Wittn AG. Ruhr, Germany	98% oxygen blows into molten raw iron at 2,500–3,500 C. Furnace requires no input of energy from gas, oil or electricity.	Commercial.
Tantalum-niobium	Solvent extraction		Hydrated oxides are dissolved in a mixture of HF and H_2SO_4. Treatment with methyl isobutyl ketone extracts both metals; treatment with proper mixture of HF and H_2SO_4 removes niobium from organic layer.	U.S. Bureau of Mines in Albany, Ore., is operating 1-lb./hr. continuous extraction unit. Recovers 99% of the metals.

Metals (cont.)

Product	Process	User	Features	Remarks
Thorium	Iodide refining	Metal Hydrides, Inc. Beverly, Mass.	Iodine gas reacts with crude thorium in special reactor at 500 C. Thorium tetraiodide migrates to heated electrode, decomposing into pure thorium and regenerating the iodine.	Unit produces 10 lb./week, considered maximum capacity for this type of reactor. Gives high-purity thorium.
Titanium	Sodium reduction	Electro Metallurgical Co. Ashtabula, Ohio. Mallory-Sharon Metals Corp. Ashtabula, Ohio	By reducing titanium tetrachloride with metallic sodium instead of with magnesium, resulting sponge can be water-leached. Investment per annual pound is said to be one-third to one-half that of Kroll process.	Electromet has a 7,500-ton/yr. plant on stream; M-S plant is rated at 5,000 tons/yr.
Titanium	Catalytic distillation	Fulmer Research Inst. Stoke Poges, Bucks, England	Treatment of ferrotitanium with titanium tetrachloride yields a mixture of lower chlorides. The mixture reverts to pure titanium plus tetrachloride on withdrawal from the reaction vessel.	Process, originally used for purifying aluminum, may also be useful for beryllium.
Titanium	Thermal dissociation	Kennecott Copper Co.	Titanium dioxide is reduced to titanium carbide with coke and reacted with iodine vapor. Resulting tetraiodide is dissociated to titanium and iodine at 1,100–1,700 C.	1,000 ton/yr. semicommercial unit planned.
Titanium	Scrap reclamation	Mallory-Sharon Metals Corp. Niles, Ohio	An anode, consisting of a bed of scrap titanium particles held in a basket, is suspended in electrolyte containing titanium dichloride and trichloride, and dissolved sodium. Sodium reduction, occurring at the cathode, plates out titanium.	Process, now in 5-lb./day pilot-unit stage, was developed by R. S. Dean and B. B. Raney of Chicago Development Corp.
Titanium	Catalytic disproportionation	Stauffer Chemical Co.	Hydrogen reduces titanium tetrachloride to trichloride; trichloride is then disproportionated with special catalyst to form metal and tetrachloride.	In pilot state; may also be applicable to niobium, tantalum, zirconium and others.
Titanium	Electrolytic descaling	Temco Aircraft Corp. Dallas, Tex.	Titanium parts are dipped in electrolyte consisting of mixture of hydrofluoric, sulfuric and nitric acids plus ferrous or aluminum sulfate. Scale acts as the cathode; a titanium anode completes the cell. Two current reversals at 6–36 v. descales the titanium.	Process works effectively at room temperatures and is very gentle.
Titanium	Chelation descaling	Turco Products, Inc. Los Angeles, Calif.	Titanium is first dipped in strongly alkaline bath to condition the scale. Next comes water rinse. Dip in buffered solution of a fluoride salt in nitric acid, followed by a water wash, completes descaling.	Process is being offered for licensing. Process requires precleaning.
Titanium	Electrorefining	U. S. Bureau of Mines Boulder City, Nev.	Titanium-bearing metals, serving as cell anode, are immersed in mixture of 5% titanium complex in fused sodium chloride. Product is formed as granular crystals at mild-iron cathode. Unit runs under a helium atmosphere.	A 10–20,000-amp. semicommercial cell is now being installed.
Titanium, electroplated	Goldenberg	.....	Kroll-grade titanium sponge, or scrap, makes up the anode. Electrolyte is fused bath of anhydrous magnesium chloride. Titanium plate forms, at low current densities, on steel cathode.	Process is currently being investigated by Engineer Research & Development Lab., Ft. Belvoir, Va.
Titanium powder	Electrolytic	United International Research, Inc. Long Island City, N. Y.	Titanium dioxide is electrolyzed under conditions that limit hydrogen contamination. Stability is attributed to oxide or nitride layer on particle surface.	Commercial unit produces about 15,000 lb./mo. of stable powder.
Titanium tetrachloride	Cold chlorination	.....	Titanium ore is digested in sulfuric acid; iron precipitates out as sulfate. Saturation with HCl at 0 C. precipitates a titanium complex that is then fired to tetrachloride.	Piloted by Armour Research Foundation. Process claims lower costs (ilmenite substituted for rutile).
Zinc	Blast furnace	Imperial Smelting Corp. Avonmouth, England	Low-grade zinc ores are roasted and then fed to blast furnace. Zinc vapors from furnace are led to condenser, scrubbed with molten lead, liquid zinc decanted into ingot molds.	Process uses 1 ton coke per ton zinc produced. Company has two furnaces in operation: 30- and 40-ton/day units.
Zirconium	Hafnium removal	.....	Zirconium tetrachloride, formed by reaction of zirconium carbide and chlorine, reduces to trihalide on reaction with zirconium dihalide. Trihalide breaks down on reheating to give pure tetrachloride for further processing, and more dihalide.	Developed in Australia, process rights in this country are owned by U. S. Industrial Chemicals Co. Pilot stage.
Zirconium	Solvent extraction	Columbia-National Corp. Pensacola, Fla.	Sodium zirconate is acidified with nitric acid and extracted with tributyl phosphate. Zirconium tetrachloride, formed by chlorination of the thermally decomposed nitrate, yields pure zirconium on reduction by magnesium.	Pure metal is recovered by vacuum distillation. Plant is now in partial operation.

• Petroleum & Natural Gas Products

Product	Process	User	Features	Remarks
Acetylene	Partial oxidation	Societe Belge de l'Azote Liege, Belgium	Process features improved burner design for conversion of hydrocarbon streams to acetylene; liquid ammonia solvent is used to extract 99.8% acetylene from process stream.	SBA has built 20-ton/day unit for Houllieres du Bassin de Lorraine; licensed in U.S. through Blaw-Knox and M. W. Kellogg.
Acetylene	Cracking	Tennessee Eastman Co. Kingsport, Tenn.	Natural gas and a mixture of oxygen and steam, all at 600 C., burn to produce a 2,000 C. stream of combustion products. Preheated cracking stock feeds into the stream, where it cracks. Acetylene is recovered by Hypersorption.	Process, which also yields some ethylene, is in semiworks stage.
Alkylate	Bauxite filtration	D-X Sunray Oil Co. Tulsa, Okla.	Bauxite filters after alkylate reactor remove acidic and sulfur-bearing materials from effluent; replace caustic washing.	On stream.
Aromatics	Hydrocracking	.....	Distillate oils are hydrocracked at 1,500 psi. and 850–900 F. over commercial cobalt-molybdate catalyst, giving high-methane fuel gas and gasoline-range aromatics.	Piloted at Institute of Gas Technology, Chicago, Ill.
Aromatic acids	Oxidation	Amoco Chemical Corp. Joliet, Ill. (Others)	Using liquid-phase, air oxidation of aromatic hydrocarbon feed stocks, this new process will turn out mono-, di-, and polybasic aromatic acids.	Developed by Scientific Design Co., Amoco plant is now in engineering stage.

Petroleum & Natural Gas (cont.)

Product	Process	User	Features	Remarks
Cat cracker feed	Unifining	Union Oil Co. Brea, Calif.	When cat cracker feed is hydrogenated, sulfur and nitrogen are removed, olefins are saturated. This results in increased quality and improved distribution of cracking products.	Treatment of cracking feedstock gives refiner economic outlet for reformer hydrogen.
Cresylic acids	Solvent extraction	Pitt-Consol Chemical Co. Newark, N. J.	Refinery wastes treated with CO_2 give cresylic acids and sodium carbonates. Heart cut passes to an agitated packed tower, where it is treated by countercurrent streams of naphtha and methanol. Final distillation yields product fractions.	In full production since February 1957, unit makes 20 million lb./yr. of refined products.
Crude oil	Centrifuging	.....	Athabasca oil sands, diluted with light oil, are thrown centrifugally through layer of water and chemicals. Separation is achieved by density differential. Royalite Oil Co., Calgary, Alta., is building 20,000 bbl./-day plant at its Mildred Lake site.	Process perfected by Royalite and Can-Amera Oil Sands Development Co.
Detergent alkylate	Acid catalysis	Shell Chemical Co. Essex, England	Reaction between benzene and olefins at controlled temperature in presence of acidic catalyst yields alkylate. Distillation removes it from reaction mass.	Shell's 30,000-ton/yr. plant now on stream.
Ethylene	From oil gas	Semet-Solvay Div. Tonawanda, N. Y.	Method combines two well-known processes. Cheap fuel oil converts to oil gas on vapor-phase cracking. Conventional extraction technique yields ethylene.	Product cost is claimed to be about one-third that of ethylene via steam pyrolysis.
Fuel oil	Residual conversion	.....	Hydrogenation at 700–875 F. and 500–3,000 psi. converts heavy residual stocks into fuel oil and a varying range of distillate products.	Developed by Hydrocarbon Research, Inc.; known as "H-Oil" process.
Gasoline	Fixed-bed reforming	Esso Standard Oil Co. Baltimore, Md.	Platinum catalyst is regenerated by special technique that maintains high catalyst activity; can upgrade low-octane naphthas to product ranging from 85 to over 100 research octane.	Powerforming process has been on stream for three years.
Gasoline	Hydroisomerization	Gulf Oil Co. Port Arthur, Tex.	Reforming-resistant C_5, C_6 and C_7 fractions are isomerized over suitable catalyst. High-pressure hydrogen suppresses cracking and disproportionation.	Gulf is seeking bids for construction.
Gasoline (mercaptan-free)	Dualayer extraction	Magnolia Petroleum Co. Beaumont, Tex.	Sour gasoline and caustic streams, mixed thoroughly, settle into two layers. Treatment of gasoline layer with potassium cresylate solution in countercurrent extraction units removes mercaptans.	Process economically removes about 98% of mercaptans from 30,000 bbl./day of straight-run gasoline.
Gasoline	Butane isomerization	Shell Oil Co.	Liquid normal butane contacts liquid catalyst of aluminum chloride and antimony trichloride. Three reactors in series boost product output by optimizing equilibrium.	Commercial.
Gasoline	Fluid coking	Various	Heavy residual oil is continuously cracked into gas, gasoline, gas oil and coke in fluid bed. Temperature is about 950 F.; pressure range is 5–10 psig.	Process increases gasoline yield per barrel from about 43% to 53%. Developed by Esso.
Gasoline, high-octane	Penex	.....	Pentane fractions from reforming are catalytically isomerized in presence of hydrogen; yields isopentane. Combined with reforming, process gives high octanes more economically than reforming alone.	Developed by Universal Oil Products Co.
Gasoline	Dehydrogenation	.....	Dehydrogenation of pentane-isopentane mixtures over chromia-alumina catalyst produces high-octane gasoline.	Process, developed by Houdry Process Corp., gives lower yields than isomerization.
Gasoline	Hydrocracking	.....	Heavy crudes of high asphalt and sulfur content are cracked with hydrogen and diluent at 790–840 F. and 750–1,000 psi.; boosts motor fuel content of crude.	Developed in Hungary for treating Transdanubian crudes.
Gasoline	Isomerization	.....	A mixed pentane-hexane feed stock plus hydrogen flow into a reactor which contains a precious metal (not platinum) catalyst. Isopentane and isohexane are recovered as products.	Developed by M. W. Kellogg, process is dubbed Iso-Kel.
Gasoline and coke	Gilsonite refining	American Gilsonite Co. Fruita, Colo.	Filters remove water from suspension of gilsonite, arriving at refinery via 72-mi. pipeline. Gilsonite is then melted, heated to about 900 F., and charged to a delayed coker. Hydrocarbon vapors from coker overhead lines convert to gasoline via Unifining and Platforming. Calciner changes green coke to electrode-grade product.	Refinery now turning out 55,000 gal./day of gasoline and 275 tons/day of coke.
Gasoline, natural	Fixed-bed adsorption	.....	Skid-mounted adsorption unit recovers 40 bbl./day raw gasoline from lean natural gas streams; attractive payout time.	Developed by Parks & Dow, Houston, Tex.
Gasoline, natural	Rotasorber	Atlantic Refining Co. St. Mary Parish, La.	Rotasorbers are rotating turntables having several beds spaced around the periphery. Wet natural gas stream passes through two of these multi-bed units; one is silica gel, the other activated charcoal. Beds are alternately fed with gas and purged to recover gasoline and LPG.	Process, engineered by Jefferson Lake Sulfur Co., has capacity of 40 million cu. ft./day.
Hydrocarbon sulfonates	Continuous sulfonation	Surpass Petrochemical Co. Scarborough, Ont. Bunge Corp. San Paulo, Brazil Kao Soap Co. Tokyo, Japan	Feed streams of petroleum crude and oleum are simultaneously mixed and cooled. Naphtha wash removes undesirable byproducts from sulfonic acid product stream. Caustic neutralization followed by alcohol cleanup yields product.	Combined output of three plants in operation is 18 million lb./yr.
Hydrogen	Reforming	Engineer Research & Development Labs. Fort Belvoir, Va.	Diesel oil, mixed with superheated steam, vaporizes and passes through reformer containing nickel catalyst. Any carbon monoxide formed converts to dioxide and hydrogen over iron oxide catalyst in shift converter. Carbon dioxide is removed by monoethanol amine absorption.	Unit, which produces 1,000 scfh. hydrogen, is completely mobile. Developed by Girdler Co.
Lithium grease	Multistep	Surpass Petrochemical Co. Toronto, Ont.	A heavy oil cut and lithium stearate plus additives are mixed in one of two slurry tanks while other is on stream. Slurry is heated to 400 F., blended with additional oil, cooled to 140 F. Milling completes.	Finished plant will turn out 25 million lb./yr.
Naphtha, coker	Electrical nitrogen removal	Ohio Oil Co. Robinson, Ill.	Coker naphtha is mixed with spent alkylation acid; electric field in contactor coalesces dispersed phase and separates out acid. Electric field is also used to remove alkaline washwater from second-stage neutralization.	Unit handles 1,000 bbl./day.

Petroleum & Natural Gas (cont.)

Product	Process	User	Features	Remarks
Naphtha reforming stock	Hydrogen treating	Esso Standard Oil Co.	Catalytic hydrogen-treating removes sulfur and other catalyst poisons from naphthas, reduces tendency of feedstock to corrode reforming equipment.	Commercial application will increase with rise in demand for higher product purity.
Oil, dewaxed	Extractive crystallization	Standard Oil Co. (Ind.) Whiting, Ind. L. Sonneborn Sons Petrolia, Pa. Deutsche Erdoel A.G. Heide, Germany	A very low-pour-point oil is produced by selectively locking wax-forming paraffins into filterable urea-complex crystals. Process involves addition of urea to charge oil at normal temperatures, followed by filtration and distillation of methylene chloride solvent.	No refrigeration required.
Oil, shale	Retorting	Union Oil Co. of Calif. Grand Valley, Colo.	Crushed oil shale feeds upward through vertical retort; kerogen content decomposes to gases and oil vapor. Vapor condenses while preheating incoming shale. Heat conservation techniques provide preheated combustion air and cooled products.	Prototype retort has capacity of 900 tons/day of shale; operates at less than $1/bbl.
Reformer feed stock	Desulfurization		Acid-treating plus electrostatic mixing and coagulation removes almost all sulfur in reformer feed stocks. Investment and operating costs are said to be less than for hydrodesulfurization.	Developed by Howe-Baker Corp.
Synthesis gas	Autothermic reforming		Process uses single fixed bed of catalyst, requires no external heat source, operates continuously, requires no oxygen supply. It converts feed stocks to hydrogen-rich synthesis gas.	Process has been operated successfully by five foreign concerns; licensed in U.S. by Gas Machinery Co.
Wax, oil-free	Spray deoiling	Edeleanu Co. Frankfurt, Germany	Small wax particles are formed in stream of air; resulting film of oil on particle surfaces is dissolved with dichloroethane.	Cost of plant is around $40 pre annual ton of charge.

• Plastics, Resins & Rubber

Product	Process	User	Features	Remarks
Ethylene oxide resins	Polymerization	Union Carbide Chemical Co. So. Charleston, W. Va.	As many as 100,000 ethylene oxide units are linked to form water-soluble resins, called Polyox resins.	Semi-commercial. Large-scale unit is scheduled for 1960.
Fluorinated rubber	Polymerization	Du Pont Co. Carney's Point, N. J.	Rubber is copolymer of vinylidene fluoride and hexafluoropropylene. The latter monomer has never been produced before.	Commercial. Product said to possess an unprecedented combination of fluid and heat resistance.
Neoprene, vulcanized	Continuous	D. S. Brown Co. North Baltimore, Ohio (Others)	Extruded rubber section is passed directly into bath of molten metal or organic fluid maintained at 400–600 F. Full vulcanization takes 20 to 30 sec. for most cross-sections.	Developed by Du Pont for neoprene solid and foam, process is expected to be used on other rubbers including GR-S.
Nylon cord	Gum impregnation	Firestone Tire & Rubber Co. Akron, Ohio	Cord is impregnated with gum-dipping solution of liquid rubber and chemicals. To lower nylon's resiliency, cord is kept under 30,000 psi. tension at 450 F. during dipping.	Process gives greater adhesion between plies of cord and between cord and thread in rubber tires.
Plastics	Pressure preforming	Pressurform Container Corp. Swarthmore, Pa.	Precisely shaped skeletons of finished articles are made continuously and automatically by molding cellulose-glass fiber slurry. Resulting dried preform is ready for p astic impregnation.	Developed by Pressurform Co., takes hand operations out of making glass-fiber reinforced articles with non-uniform thickness.
Plastics	Irradiation	Sequoia Process Corp. Redwood City, Calif.	Plastic is subjected to 1 x 10^6 to 1 x 10^8 roentgens, then thermally cured at 130–160 C. Special additives compatible with the plastic aid this process for improving strength and temperature-resistance. Sequoia is using process to turn out coated wire.	Developed by Sequoia Process Corp. Licensing rights transferred to W. R. Grace, currently conducting research to extend process useability.
Plastics, pressed	Preheating	Elektroinstallation Ruhla East Germany	Mechanical and electrical properties of pressed plastics are said to be improved by high-frequency preheating. Also said to reduce pressing time and pressure required.	Commercial.
Plastic sheets	Continuous polymerization	Swedloe Plastic Co. Los Angeles, Calif.	Liquid monomer, mixed with catalyst, flows between two translucent sheets. Continuous monomer film polymerizes into a sheet under action of ultraviolet light.	Patent granted.
Plastics, sterile	Ethylene oxide	Abbott Laboratories Chicago, Ill.	Plastic hospital equipment is sterilized with ethylene oxide right in cartons.	Makes possible use of plastics that cannot stand heat.
Polycarbonates	Polymerization	General Electric Co. Pittsfield, Mass. Bayer, Uerdingen Germany	One of several possible production techniques, disclosed by Bayer, involves emulsion of a polyphenol in methyl chloride, addition of caustic solution and phosgene plus a quaternary ammonium hydroxide catalyst.	Development-scale output of GE product is called Lexan.
Polyester film	Polymerization	Goodyear Tire & Rubber Co. Apple Grove, W. Va.	Material is probably based on a mixture of dimethyl terephthalate and dimethyl isophthalate.	Commercial. Film, called Videne, heat seals, adheres to variety of other materials.
Polyethylene, low pressure	Directed polymerization	Various	Ethylene polymerizes over a metal-alkyl mixed catalyst at 70–200 F. and near-atmospheric pressure. The polyethlene, formed as slurry with catalyst and diluent, is separated as a solid, purified and dried. Pelletising is final step.	Using Phillips Petroleum Co. process; Phillips, Pasadena, Tex.; Celanese Corp. of America, Houston, Tex.; W. R. Grace Co., Baton Rouge, La. Using Ziegler process: Hercules Powder Co. Union Carbide, licensee of both processes, is in production at Institute, W. Va.
Polyethylene, irradiated	Electron bombardment	General Electric Co. Pittsfield, Mass.	Undisclosed modifying resins (similar to antioxidants conventionally used in rubber) are key to creating stable cross-linking by irradiation.	New facility turns out 1.6 million lb./yr.
Polyoxymethylene	Polymerization	Du Pont Co. Parkersburg, W. Va.	Controlled-rate polymerization prevents formation of unstable links in the polyoxymethylene chain, gives tough, crystalline polymer.	Commercial. Sold under the trade name Delrin.

Plastics, Resins & Rubber (cont.)

Product	Process	User	Features	Remarks
Polypropylene	Directed polymerization	Montecatini, Italy Hercules Powder Co.	Using special catalysts (probably metal-alkyl and metal-halide types), propylene polymerizes in a poly-a-butylene form; isotactic structure has high melting point and high tensile strength.	Montecatini and Hercules are in production. Polymer will go into molded products, film, fibers.
Retread tires	Curing	Goodyear Tire & Rubber Co. Akron, Ohio	Heat, applied inside casing in retreading mold as well as from mold itself, cuts curing time 50% and gives more uniform cure.	Goodyear purchased rights to process from Gibbs Research & Mfg. Corp.
Rubber	Water mixing	Columbian Carbon Co. Hancock, La.	Turbulent stream of carbon black in water mixes with latex in a nozzle and coagulates. Washing yields the crumbs.	Process makes stronger rubber. Four rubber companies have taken licenses with Columbian.
Synthetic "natural" rubber	Directed polymerization	Firestone Tire & Rubber Co. Akron, Ohio Goodyear Tire & Rubber Co. Akron, Ohio B. F. Goodrich Co. Avon Lake, Ohio	Polymerization of isoprene. Firestone uses lithium catalyst; other two producers use Ziegler-type catalyst.	Firestone (Coral) and Goodyear (Natsyn) pilot plants started up early this year. Goodrich (Ameripol-SN) has been in pilot production for some time.
Synthetic rubber tires	Latex dip bonding	Pennsylvania Tire Co. Mansfield, Ohio	Latex dip permits bonding butyl rubber to tire cords; gives 100% synthetic rubber tire that is ozone-resistant.	Used to fabricate tires for Army.
Urethane foam	Spray insulation	.....	A prepolymer, catalyzed in a special train of spray equipment, forms a polyurethane foam on any surface. Application rate of 12 sq. ft./min. cuts insulation time for a 1-in. thick layer to one-twelfth normal.	Several firms have developed equipment.
Vinyl foam	Mechanical foaming	Various	Continuous foaming equipment meters vinyl plastisol and inert gas accurately, simultaneously and under pressure; mixes and cools the two; continuously discharges foam into molds.	Developed by Elastomer Chemical, process is licensed to some 25 firms.
Vulcanized rubber	Nuclear irradiation	B. F. Goodrich Co. National Reactor Testing Station, Arco, Idaho	Tire in a steel mold is vulcanized by rotating it over radioactive fuel elements in water-filled canal.	Irradiated tires wear longer and withstand deterioration better.

• Pulp & Paper

Product	Process	User	Features	Remarks
Black liquor recovery	Mead	Mead Corp. Lynchburg, Va.	Black liquor is smelted in special furnace, smelt converted into neutral sodium sulfite liquor by carbonation, and neutral liquor sulfited with flue gases. Process yields ready-to-use cooking liquor for pulp digestion.	Process claims 97% sodium recovery and 92% sulfur recovery.
Paper	Jet drying	Gilbert Paper Co. Menasha, Wis.	Paper, entirely supported on both sides by air jets ¾ in. apart, passes through an enclosed dryer.	Dryer utilizes 300 F. air.
Paper, extensible	Clupak	West Virginia Pulp & Paper Co. Charleston, S. C.	During drying, shrinking process compresses paper lengthwise and crosswise enabling it to stretch in service up to 13%.	Product resists greater shock loads than any other paper.
Paper, reprocessed	De-inking	.....	Paper is shredded, put in water and ink removed by addition of a detergent and salt. Mix is heated and electric current is passed through to increase separation of ink from cellulose.	Product said to be as good as virgin pulp. Developed at the University of Texas.
Paper tissue	Forming	Erving Paper Mills Erving, Mass.	Pulp is pressure-sprayed on cylinder machine, followed by drum drying, creping and rewinding. Tissue is soft, stronger than tissue formed on a fourdrinier.	Crown Zellerbach has plans to install several machines at various plants.
Pollution control	Aeration in turbines	Various	Process cuts down sulfite-mill BOD loading on streams by injection of air into existing turbines generating hydro power.	Purpose is to preserve game fish, which require a minimum of 3 ppm. oxygen in the water. Experimental at several mills.
Pulp	Pandia continuous	Champion Fibre Co. Canton, N. C. Potlash Forests, Inc. Lewiston, Idaho	Conveyor screws propel cooking mass of wood chips through bank of 36-in.-dia. tubes, 21 ft. long. High operating temperatures result in shorter cooking times.	Process yields 60 tons/day at Champion; PF has a 125-ton/day plant.
Pulp	Kamyr continuous	International Paper Co. Camden, Ark.; Gulf States Paper Co., Demopolis, Ala.	Tall, vertical tower continuously digests wood chips under normal conditions of time and temperature.	IP's new unit turns out 150 tons/day, Gulf States, 300. Developed by Swedish firm, Kamyr. Several European installations.
Pulp	Hydrotropic pulping	Cuban Pulp & Paper Co. Havana, Cuba	Process claims no objectionable effluent, simple operation and one-third reduction in pulping costs.	Licensed by McKee Development Corp.
Pulp, groundwood	From hardwood chips	Gould Paper Co. Lyons Falls, N. Y.	Hardwood chips are pressure-impregnated with caustic, pressed dry and then fiberized by double- and single-disk refiners.	System handles 40 tons/day.
Pulp, nodular	Extrusion	East Texas Pulp & Paper Co. Evadale, Tex.	Unbleached stock, supplied by a Bingham pump, is pushed through a Zenith press to yield "noodles" consisting of 40% pulp and 60% water.	Nodular pulp is easy to make, handle and transport.
Pulp, pelletized	Pneumatic pelletizing	.....	Complete system for pelletizing denodulizing, drying and handling pulp pneumatically is expected to effect substantial reduction in costs of shipping and handling.	Developed by Sprout, Waldron Co., Muncy, Ind.
Pulping chemicals	Recovery	Consolidated Water & Paper Co. Wisconsin Rapids, Wis.	Process converts semichemical or sulfite spent pulping liquor to easily processed, noncorrosive, kraft-type liquor that can be handled in regular kraft-mill recovery equipment.	Byproduct steam value is determining factor in justifying soda ash recovery.
Sulfite liquor products	Spray drying	Robeson Process Co. Erie, Pa.	Spray-drying high-acid waste sulfite liquor bypasses severe corrosion problem encountered with drum dryers.	Unit handles 16 tons/day of dry product.

• Synthetic Fibers

Product	Process	User	Features	Remarks
Acrylic fibers	.....	Various	Dow's new acrylic, Zefran, is described as a nitrile alloy, claims versatility in processing and dyeing of fibers. Also on tap are Cyanamid's Creslan and Tennessee Eastman's Verel.	Dow has an estimated 14-million lb./yr. plant at Lee Hall, Va.; Cyanamid—27 million lb./yr. at Pensacola, Fla.; Eastman—12-15-million lb. at Kingsport, Tenn.
Antistatic Arnel	Surface treatment	Celanese Corp. of America Charlotte, N. C.	Process, which causes chemical change in surface of Arnel fiber, leaves a nonremovable, hydrophilic, antistatic skin constituting about 2% of fiber weight.	Process does not work on polyesters, acrylics or nylon.
Carbon fibers	Carbonization	Atomic Laboratories Inc. Berkeley, Calif.	Accurate heat control permits carbonization of rayon fibers to pure carbon fibers.	.....
Carbon fibers	Pyrolysis	Pittsburgh Coke & Chemical Co. Neville Island, Pa.	Pyrolysis of dilute hydrocarbon gas over spherical surfaces of silica, nichrome or alundum yields a mass of fibrous "whiskers."	Fibers are available in limited quantities for experimentation.
Ceramic fiber	Blending	Carborundum Co. Niagara Falls, N. Y.	Fiberfax ceramic fiber is made from a blend of 80-85% long staple ceramic fiber and 15-20% organic carrier fiber condensed to single strand and twisted.	Withstands temperatures above 2,000 F., available commercially.
Cotton products	Bleaching	.....	Cotton is prebleached with specially prepared hypochlorite, then, without washing, is bleached with activated hydrogen peroxide.	Developed by Allied's Solvay Process Div., said to use less H_2O_2 and take less time.
Dinitrile fiber	Extrusion	B. F. Goodrich, Chemical Co. Avon Lake, Ohio	Now called Darvan, fiber is formed by extruding polymer of vinylidene dinitrile, removing solvent and stretching resulting yarn. Fiber resembles acrylics in some respects.	In pilot production.
Polyamide fiber	From castor oil	Organico Co. France	Fiber, called Rilsan, is said to have high degree of dye absorption, greater covering power than nylon, be non-allergic and have a softer hand than nylon.	One plant at Marseilles alone uses 10,000 tons/yr. castor oil to turn out 3,500 tons of Rilsan.
Microfibers	Spraying	American Viscose Corp. Marcus Hook, Pa.	Polymers, dissolved in volatile solvents, are sprayed into an airstream.	Fibers have permanent electric charge, range in diameter from 0.5 to 10 microns.
Polyester fibers	From waste pulp liquors	.....	Vanillin in waste pulp liquors is converted to protocatechuic acid and then to polyester fibers. Fibers have tensile strengths as high as 4.4 grams per denier and good dyeing properties.	Developed by Rayonier, fibers are still in experimental stage.
Polyethylene fibers	.....	Various	Newer linear polyethylene reportedly has properties exceeding saran and approaching nylon; features greater strength and tenacity, low melting point.	New uses are expected to boost polyethylene fiber consumption to 10 million lb./yr. by 1960's.
Polyurethane foam yarn	Slicing	.....	Yarn is made by cutting blocks of plastic foam into continuous bands varying from 2x2 mm. to 6x6 mm. Yarn can then be overspun with cotton or other textiles to add strength and reduce elasticity.	Developed in West Germany by Rekord Gummiwerke in Stuttgart. Experimental.
Rayon, high-strength	.....	American Viscose Corp. Philadelphia, Pa.	Yarn made from new staple is 70% stronger when wet and 40% stronger dry than conventional rayons; is compatable with acrylics and polyesters for blends.	Available in limited commercial quantities.
Rotproofed fibers	Polymerization	Tee-Pak, Inc. Chicago, Ill.	Protective coating of acrylonitrile, chemically bonded to carboxyl groups of the cellulose in fabric fibers, forms in presence of ferric ion catalyst.	Monsanto and American Cyanamid developed the process.
Submicron fibers	Hot-melt polymer extrusion	.....	Extruder, having a row of tiny orifices in nozzle, forces hot thermoplastic material into converging streams of hot air. Fibers produced are collected on a moving screen. Charge materials include wide variety of thermoplastics.	Fibrous mat produced shows excellent filter properties. Work by Naval Research Lab.
Teflon fiber	Heat sintering	Du Pont Co. Richmond, Va.	Resin emulsion is heat-sintered rather than extruded; gives a fiber that has high heat and chemical resistance.	Fiber is suited for such applications as filtration of oxidizing acids, packing of acid pumps.
Textiles	Fluidized bed	.....	Sand bed is fluidized, electrically heated and then cloth passed through it. Method can be used for drying, dyeing, baking resins or padding pigments.	Experimental process underway at British Rayon Research Assn., Manchester, Eng.

• Nuclear Materials & Technology

Product	Process	User	Features	Remarks
Boron-10	Distillation	Hooker Electrochemical Co. Niagara Falls, N. Y.	Natural boron trifluoride is converted to dimethyl ether-boron trifluoride complex by treatment with DME. Complex feeds to a six-tower distillation train. Boron-10-enriched complex leaving the train is converted to potassium fluoborate, then electrolyzed.	Hooker was contract operator for AEC; plant now shut down.
Fusion studies	Fusion reactors	Various	Work aims to provide energy by controlling fusion of heavy hydrogen at high temperatures in strong magnetic fields.	Program in experimental stage.
Heavy water	Dual-temperature exchange	Atomic Energy Comm. Aiken, S. C. Dana, Ind.	Deuterium in natural water exchanges with H in H_2S at 100 C. Contacting this deuterium-rich H_2S with water at 25 C. reverses equilibrium and enriches water with deuterium.	Repeated passes increase deuterium content from 0.015% to 15%. Electrolytic enrichment follows.
Heavy water	Hydrogen distillation	Farbwerke Hoechst Germany	Hydrogen-deuterium molecules in liquid-hydrogen feed are concentrated from 0.03% to 95% by two successive distillations. The 95% stream is catalyzed to yield a 25%-pure-deuterium feed stock for a third distillation. Pure deuterium from this operation is oxidized to heavy water.	National Bureau of Standards is building a 60-lb./yr. pilot plant. Hoechst's plant is about ready to start production of 12,000 lb./yr.
Heavy water	Three-stage	.....	First stage uses ion-exchange equipment and electrolytic cells; enriches to 2% D_2O. Second-stage distillation concentrates to 40%; final electrolysis yields 99.3% D_2O.	Pilot unit producing 100 lb./yr. operating near Tokyo, Japan; also studying dual-temperature heat exchange process.

Nuclear Technology (cont.)

Product	Process	User	Features	Remarks
Moderator studies	Organic-moderated reactor	National Reactor Testing Station Idaho Falls, Idaho	Feasibility of using hydrocarbon coolant as medium for dissipating heat from reactor core is purpose of present study.	Experimental stage.
Nuclear energy..	Boiling-water, heterogeneous reactor	Argonne National Laboratory Lemont, Ill.	Enriched uranium fuel elements are submerged directly in bath of light water which serves as both moderator and coolant. Heat of fission boils the water; generated steam drives turbine.	Turning out 5,000 kw., it was first U.S. reactor to generate electricity on a continuous basis.
Nuclear energy..	Pebble-bed reactor	Atomic Energy Commission Arco, Idaho	Reactor fuel consisting of pelletized graphite and uranium dioxide contained in vertical parallel tubes will make it possible to provide high-temperature, high-pressure steam for existing turbogenerators.	Experimental station being designed by joint effort of Sanderson & Porter and Alco Products.
Nuclear energy..	Shippingport reactor	Duquesne Light Co. Shippingport, Pa.	With a pressurized water reactor as its heat source, the United States' first large-scale nuclear power plant has a 60,000-kw. net capacity. Operation will be aimed at advancement of technology rather than continuous maximum power output.	Reactor went critical on Dec. 2, 1957, began furnishing usable power on Dec. 18.
Nuclear energy	Sodium reactor experiment	Atomic Energy Commission Santa Susana Mtns., Calif.	Reactor is graphite-moderated and in heterogeneous class. It is fueled with enriched uranium and cooled with liquid sodium. This coolant permits high-temperature (960 F.) operation at atmospheric pressure.	Reactor size is 20,000 thermal kw. Of this, 6,500 kw. can be tapped as electrical power by Southern Calif. Edison.
Nuclear energy	Gas-cooled reactor	Calder Hall Station Sellafield, Cumberland, England	Carbon dioxide coolant stream transfers heat from graphite-moderated reactor to water side of four heat exchangers. Steam produced turns turbogenerators to the tune of 92,000 kw.	Byproduct plutonium greatly reduces cost of power developed.
Nuclear energy	Plutonium reactors	General Electric Co. Richland, Wash.	Plutonium-enriched uranium fuel will be used in heavy-water moderated reactor to generate 186,000 lb./hr. steam.	Plutonium is produced as by-product of uranium-fueled reactors. Experimental stage.
Nuclear energy	Package power reactor	U.S. Army Ft. Belvoir, Va.	Light water under pressure cools and moderates reactor. Fuel is 90%-enriched uranium clad in stainless steel. Reactor is designed for transport to remote military areas.	Built by Alco Products.
Nuclear energy	Pressurized-water reactors	U.S.S.R.	Water-moderated plant, still in development stage, will utilize two pressurized-water reactors to turn out 420,000 kw. of electrical power.	Largest U.S. station, planned for 1962, is to be 200,000 kw.
Radiation exploration	Homogeneous water-solution reactor	Armour Research Foundation Chicago, Ill.	Aqueous solution of uranyl sulfate, held in 4-gal. spherical tank, acts as fuel-moderator for reactor. Boron control rods, stainless steel cooling coil and recombiner tank complete the list of vital elements.	Reactor will aid study of radiation effects on chemical reactions and unit operations.
Radioactive waste disposal	Underground tunnel	General Electric Co. Hanford, Wash.	Radioactive equipment or waste materials, loaded on railroad cars, will be stored within concrete tunnel, barricaded by water-filled radiation barrier gate.	Tunnel holds 12 loaded flat cars.
Reactor-component testing	Engineering test reactor	National Reactor Testing Station Idaho	ETR is heterogeneous reactor fueled with aluminum-clad uranium-235. Light water moderates; reflector is beryllium surrounded by aluminum.	ETR will test reactor components; it has highest average neutron flux.
Reactor studies..	"Slow-fast" reactor	Argonne National Laboratory Lemont, Ill.	A 5-foot-dia. steel tank contains "heart" or "fast" reactor surrounded by "slow" reactor. "Fast" section uses enriched uranium fuel, "slow" uses mixture of normal and enriched fuel elements.	Engineers will use the unit to study fundamentals of power reactors.
Uranium.....	Solvent extraction	Kerr-McGee Oil Ind. Shiprock, N. M.	Acid-leach liquor is mixed with special solvent in series of four mixer-settler extractions. Pregnant solvent is treated with soda ash solution to remove uranium. Ammonia precipitation completes 99.7% recovery.	Solvent is di-2-ethyl hexyl phosphoric acid and tributyl phosphate dissolved in high-flash-point kerosene.
Uranium.....	Oxidation.....	National Lead Co. Grand Junction, Colo.	During leaching, oxidation of low-valence uranium with air in presence of copper sulfate and ammonia replaces conventional potassium permanganate oxidation.	This change cuts leaching time from two days to 80 min.
Uranium.....	Modified Infilco-Techmanix	Union Carbide Nuclear Co. Maybell, Colo.	Air agitation aids contacting of anion exchange resin and pregnant pulp or liquor. The pulp and resin are separated after each stage by settling. Final steps are elution, recirculation of the resin and recovery of the uranium.	Process applies to other fields, such as sugar processing and pharmaceuticals. Developed by Techmanix Corp., Tucson, Ariz.
Uranium.....	Excer.....	.....	Believed to involve ionic membranes as diaphragms in electrolytic cell. Gives granular electroprecipitates that are easy to handle.	Vitro Corp. is planning a 2,000-ton/yr. plant. Researched by Ionics, Inc., and Rohm & Haas.
Uranium.....	Solid-solvent extraction	.....	Uranium-bearing liquor or pulp is mixed with special activated carbon. Selective solvent, adsorbed on carbon, is specific for uranium salts. Screening the carbon from the pulp, followed by stripping, frees the product.	Process in laboratory stage, developed by Arthur D. Little Inc.
Uranium.....	Solvent extraction	.....	Carbonate leach solution is treated with 8-hydroxyquinoline to form single charged complex uranium anion. Anion is then extracted into suitable organic solvent by singly charged organic cation.	Under bench-scale investigation by Arthur D. Little, Inc.
Uranium.....	Solvent leaching.	.....	Process, which requires no water, involves percolation of mineral acid-solvent-diluent mixture through ore on a porous or perforated moving belt. Bypasses all conventional processing steps to give yield of about 85% of ore's uranium.	Three companies are working on process. National Lead uses nitric acid and tributyl phosphate; Dow uses octyl phosphoric acid-hexane-sulfuric acid system; Battelle uses HCl and acetone.
Uranium.....	Two-step leaching	.....	Solubilization step involves treatment of ore with buffered solutions of sodium carbonate-bicarbonate. Minerals, oxidized and carbonized by this step, are then leached with sulfuric acid.	Process is through pilot-plant stage. It boasts recoveries of 96% or better. Developed by Macafee & Co., Los Angeles, Calif.
Uranium-235....	Centrifuging.....	Bonn University Germany	A battery of eight 7 x 47-in. centrifuges, developing about 100,000 g.'s, will separate U-235 hexafluoride from the U-238 isotope.	Power costs on commercial prototypes are expected to be 10–12% of gaseous diffusion costs.

Nuclear Technology (cont.)

Product	Process	User	Features	Remarks
Uranium dioxide	Three-step	Mallinckrodt Chemical Works Hematite, Mo.	Enriched uranium hexafluoride converts to ammonium diuranate on hydrolysis and subsequent ammonia treatment. Diuranate is converted to U_3O_8 by pyrohydrolysis in presence of steam, then reduced to dioxide by hydrogen.	Oxide is destined for fabrication into ceramic or cermet reactor fuel elements.
Uranium hexafluoride	Fluorination	Allied Chemical & Dye Corp. General Chemical Div.	Distillation process recovers volatile hexafluoride product from fluorination of crude uranium concentrates.	Five-year government contract for 5,000 lb./yr. U_3O_8 has been negotiated.
Uranium	Solvent extraction	Vitro Uranium Corp. Salt Lake City, Utah	Clarified liquor from sulfuric acid leaching process is extracted with dodecyl phosphoric acid-kerosene solution. Uranium, stripped from DDPA by strong HCl solution to give UO_2Cl_2, is then precipitated with ammonia. Diuranate is calcined to yield U_3O_8 as hydroxide.	This method has replaced Vitro's 550-ton/day uranous phosphate precipitation process.
Uranium oxide	Electrolysis	.....	Electric current is passed through boiling-water slurry of crushed ore, depositing uranium metal on steel plates. Metal, removed from the plates, is converted to oxide by nitric acid treatment.	Method claims 95% extraction of available uranium in the ore. Process being developed by Electro Winning Corp. and Yucca Mining & Petroleum Co.
Uranium tetrafluoride	Solvent extraction	Dow Chemical Co. Pittsburg, Calif.	Uranium, reduced in valence by iron, aluminum or electrolysis, is extracted from high-chloride liquors as uranium chloride anion complex. Treatment of complex with hydrofluoric acid precipitates uranium tetrafluoride.	No further refining of precipitate is necessary to meet AEC specifications.

• Technology Advances

Operation	Equipment	User	Features	Remarks
Air-pollution control	Wind-tunnel model	New York University New York, N. Y.	Scale model of existing or proposed plant is tested in special wind tunnel to observe patterns of effluent dispersion in atmosphere.	Kaiser's fume-disposal system at Chalmette, La., plant was tested with this technique.
Automatic data handling	Electronic instrumentation	Tidewater Oil Co. Delaware City, Del.	New refinery features continuous automatic scanning, logging, integrating of process variables in each of 13 process units.	Equipment was engineered and installed by Panellit, Inc., Skokie, Ill.
Bin unloading	Cone plug	.....	Cone plug in special hopper attachment eliminates funneling, rat-holing and clogging in bin.	Developed by Bituminous Coal Research Inc.
Bio-oxidation	Aerator	.....	Waste-sludge contact, aeration and sedimentation of high-BOD waste streams is handled continuously in single piece of equipment.	Infilco is turning out two different designs under trade name of Aero-Accelator.
Electric current generation	Fuel cell	U.S. Army Electronic Proving Grounds Ft. Huachuca, Ariz.	Hydrogen and oxygen convert directly to electricity in cell. Operates at 1 atm. and 130 F.; special porous, hollow carbon electrodes immersed in KOH electrolyte are secret of cell's operation.	National Carbon Co. developed; Army uses cell to provide silent power for portable radar set. Pitt-Consol is piloting a coal-fueled cell.
Chemical milling	Etching tank	Turco Products, Inc. Los Angeles, Calif.	Metal stock, first thoroughly cleaned and masked, is immersed into etching solution until desired depth of etch is attained.	Cost studies show that chemical milling is competitive with machine milling.
Compacting	Agglomerating & disintegrating	Duval Sulphur & Potash Co. Carlsbad, N. M.	Fines from potash production feed to compacting mill where they are squeezed into continuous sheet. Sheet is broken into chunks and then granulated to marketable mesh by roller mill.	Allis-Chalmers Mfg. Co. developed process.
Corrosion-rate determination	Corrosometer	.....	Change of electrical resistance caused by surface corrosion of metal probe is principle of operation. Metal chosen for probe is same as that of equipment being studied.	Equipment is available from Crest Instrument Co., Sante Fe Springs, Calif.
Distillation & absorption	Ripple trays	Stone & Webster Engineering Corp. Boston, Mass.	Trays are perforated sheet metal having an impressed sinusoidal-wave configuration. They eliminate need for downcomers, result in lower pressure drops, stay cleaner.	There are at least 27 installations utilizing ripple trays now operating or under construction.
Drying	Double-walled spray dryer	Shea Chemical Co. Dallas, Tex.	Double-walled spray tower, designed for drying sodium phosphate slurry, eliminates need for costly insulation. Hot off-gas from calciner, passing upwards through annular space, provides insulating envelope.	In addition, calciner off-gas provides some of required heat at top of tower.
Electrostatic beneficiation	LeBaron-Lawver separator	International Minerals & Chemical Corp. Topsham, Me.	Minerals to be beneficiated are first heat treated to alter particle surfaces. Charge builds up by particle-to-particle contact. As ore falls between successive pairs of oppositely charged electrodes, adjustable splitters separate negatively charged particles from those positively charged.	Separator shows promise in upgrading feldspar, potash and phosphate.
Evacuation	Combustion-gas ejector	Graham Mfg. Co. Batavia, N. Y.	Fuel and 60-psi. air burn in Thermal burner to produce 3,500 F. combustion gases; these are cooled to 800 F. by water injection. Gas-water stream, moving through a nozzle at supersonic speeds, produces single-stage vacuum of 26 in. Hg.	Installation and operating costs for the ejector are said to be less than those for air or steam types.
Evaporation	Badger-Hickman evaporator	.....	Compression still contains rapidly rotating evaporator-condenser of sheet metal. Under centrifugal force, liquid films on both sides of rotor are maintained so thin that overall heat transfer coefficients are around 2,500–6,000 Btu./(hr., sq. ft. °F.)	Test still with 8-ft. rotors has been built and operated under contract with Saline Water Conservation Dept.
Fractionation	Lazy tower	Spence & Greene Chemical Co. Crosby, Tex.	Horizontal vessel fractionates liquid feed without trays or packing. Flowing along hot plate as thin film, liquid vaporizes differentially, condenses same way on arched upper surface of chamber. Enrichment proceeds towards the two ends.	Used to split tall oil. S&G estimates a cost less than $100,000 for a 5,000 lb./hr. plant.

Technology Advances (cont.)

Operation	Equipment	User	Features	Remarks
Heat transfer	Double-fired heater	Sun Oil Co. Marcus Hook, Pa.	Double-fired heaters use direct transmission of radiant heat to tube banks from two sides, rather than radiating from one side and reradiating from another.	New heaters, developed in conjunction with Alcorn Combustion Co., boost tube effectiveness by 50%.
High-temperature processing	High-intensity arc	Vitro Corp. of America West Orange, N. J.	Material to be processed forms the anode. At temperatures of 7,000–10,000 C. the anode itself rapidly vaporizes.	Pilot plant uses arc to break down manganese silicate anode. Sheer-Korman process.
High-temperature heating	Solar furnace	National Bureau of Standards (Others)	A 5-ft parabolic mirror focuses sun's rays into ¼-in.-dia. hot spot. Photocells and electronic circuit keep unit aligned with sun.	Unit produces temperatures of 3,500 C.
Ion exchange	Pulse column	Commonwealth Scientific & Research Org. Melbourne, Australia	Pulsating diaphragm at base of column passes slurries of up to 40% solids through resin bed.	Experimental.
Ion retardation	Combination resin	.....	Ion retardation is based on new resin which adsorbs both cations and anions simultaneously. Ionic substances can be water-washed from resin.	New resin, developed by Dow, is useful in separating ferrous sulfate from zinc sulfate.
Isomer separation	Clathration	Union Oil of Calif.	Treatment of feed, consisting of hard-to-separate isomers, with solid complex ties up desired isomer. Solvent removes isomer from complex. Solvent is recovered by stripping. Process is extremely selective.	Over 100 different complexes, each consisting of a metal atom, an anion and a nitrogen compound are available.
Mining	Soil freezing	Morton Salt Co. Weeks, La.	Vertical steel pipes for circulation of refrigerated brine are placed in earth to depth dependent on soil conditions. After allowing sufficient time for soil to freeze, the shaft is sunk. First such application in Western Hemisphere.	Method permits sinking of shafts when subsurface moisture conditions limit regular methods.
Odor elimination	Packed sodium hypochlorite tower	Pacific Adhesives Co. Beaverton, Ore.	Plant foul air passes through cyclone and then water scrubber to remove dust. It then contacts aqueous sodium hypochlorite solution in packed tower and vents to atmosphere.	Unit handles 100 cfm. foul air for capital outlay of $4,000 and running cost of $0.40/hr.
Phenolic waste removal	Solvent cleanup	Allied Chemical & Dye Corp. Barrett Div. & Wilputte Coke Oven Div.	Barrett's process uses a heavy aromatic solvent in a rotating-disk contactor to extract phenolics from waste streams. Wilputte's process uses a light aromatic oil in a Podbielniak contactor. Both feature caustic soda regeneration of solvent.	Barrett's 12,000 gal./day unit knocks phenol down to 5 ppm. Wilputte has installed a 200,000 gal./day unit for Wierton Steel Co.
Plant design	Scale models	Dewey & Almy Chemical Co. Cambridge, Mass.	In building a new pilot plant, no engineering drawings were used—only scale models. A layout model led to optimum design for available space, a piping model to faster, lower-cost construction. Millwrights and pipers worked right from models.	Operators for new unit also trained with aid of the models.
Preloading tank sites	Sand dunes	Esso Standard Oil Co. Bayonne, N. J.	Sand or other abundant heavy materials are piped over proposed tank sites, compressing soft soil below. This prevents subsequent settling after tank is in use.	Mound-making activities usually start about one year prior to tank construction.
Process-stream analysis	Lab-on-wheels	Sun Oil Co. Marcus Hook, Pa.	Mobile truck-laboratory drives to trouble points to analyse streams or solve design and operating problems.	Lab carries gas chromatograph, data logger and computer.
Reactor mounting	Ball bearings	Socony Mobil Oil Co. Paulsboro, N. J.	Catalytic reformer reactors and charge exchangers are mounted on ball bearings and float freely in recycle piping system, eliminating expansion joints. Allows closer equipment spacing, saves on piping, reduces pressure drop.	Used in 20,000-bbl./day reforming unit.
Semiprecision molding	Sodium silicate sand molds	.....	Sodium silicate is mixed with fine sand and rammed into mold pattern. Gassing with CO_2 forms silica gel that binds grains firmly.	National Cylinder Gas Co. developed. Process is fast, cheap and gives casting tolerances up to 0.2%
Sewage combustion	Zimmermann pressure reactor	Metropolitan Sanitary District Chicago, Ill.	Sludge from raw treatment is reacted with compressed air in reactor at 1,000–1,500 psi. and 480 F.; leaves fine ash and water.	Developed by Sterling Drug, Inc.
Shipping heat-sensitive goods	Via temperature-stabilizing chemicals	.....	Cans of the chemical will maintain any even temperature between 40 and 120 F., as specified by shipper, by absorbing or releasing 300 Btu. of latent heat.	Chemical, developed and produced by Jet-Heet, Inc., has trade name Transit-Heet.
Slurry storage	.....	Various	Unloading dry product, and mixing with water for slurry storage, saves money and space over storing dry.	Example: A 10,000-gal. tank holds 75,000 lb. soda ash in slurry form compared to 47,000 lb. stored in dry form.
Solids dissolution	Liquilizer	Amalgamated Sugar Co. Ogden, Utah	Device attaches to discharge port of railroad car. Pump suction draws solids from car and mixes them with jet of water.	System used for dissolving granulated beet sugar. Unloads 28,000 lb./hr.
Solids transport	Pipeline	American Gilsonite Co. Grand Junction, Colo. Pittsburgh Consolidation Coal Co. Pittsburgh, Pa.	American Gilsonite delivers 700 tons/day of minus 8-mesh gilsonite as a 35% suspension in water. Pitt-Consol is piping 14-mesh bituminous coal 108 mi. at a 3,600-ton/day clip.	American Gilsonite's 72-mi. pipeline is operational; Pitt-Consol is starting up.
Thermal diffusion	Permeable membrane	.....	Materials to be separated flow in plastic channels between a hot and cold plate. Two products separate by diffusion through cellophane membrane.	Developed on laboratory scale at University of Tennessee.
Thermal photography	Far-infrared camera	Barnes Engineering Co. Stamford, Conn.	Special camera produces photographic image of thermal condition of any object. Top performance in 0–500 F. range permits detection of temperature differences as small as 0.4 F. Reference marks along side of picture give quantitative idea of temperature.	May find application in tank gaging, location of process hot-spots or faulty insulation, etc.
Thermal photography	Camera	North American Aviation Rocketdyne Div. Canoga Park, Calif.	Camera photographs flame under consideration along with four different lamps of known temperature. Film density is then correlated with flame intensity.	Method is accurate to 10 deg. between 1,000 C. and 2,000 C.
Water conservation	Via cetyl alcohol	U.S. Bureau of Reclamation Oklahoma City, Okla.	Reservoir-water evaporation losses are cut 45–64% by maintaining continuous monomolecular layer of cetyl alcohol on the surface. Experimentation showed little or no undesirable effects.	Similar program met with excellent success in Australia.
Wine cleanup	Ion exchange	Wente Bros. Co. Livermore, Calif.	Ion exchange now replaces chill stabilization as means of removing potassium and calcium contaminants. A phenolic-base, sulfonic-acid, cation-exchange resin is mixed with wine and then filtered out.	Process eliminates need for costly refrigeration equipment and operation.

If you keep these guides and examples handy when you design air pollution control systems, you won't overlook any important factors.

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Dust and fumes—produced by almost every chemical plant—definitely create a dirty, smelly and, many times, harmful atmosphere near their source. Plant managers have several good reasons for controlling the amounts of released dust and fume.

Either the recovered materials or a cleaned gas means money saved and offers an economic goal for air pollution control. Often ordinances and regulations give a legal reason for cleaning up the air. And sometimes, air pollution is kept low because of a simple management desire to stay on good terms with workers and the plant's neighbors.

Whatever the reasons for controlling dust and fume, an engineer usually designs a system for cleaning dirty gases. Before beginning equipment selection and sizing he must consider a number of factors. We'll discuss these and give some examples and guides that should make the job of designing easier.

How Clean Should Air Be?

Legal ordinances on air cleanliness vary from place to place. Thus there is a wide range of requirements of particulate matter (solids content), noxious gases, opacity (visibility of smoke) and odor.[1] The limits of cleanliness are affected by air pollution control and zoning ordinances, building codes, city and state health codes and sanitation regulations.

After considering the legal limits on pollution, the engineer finds the cleaning system with the most economic recovery efficiency. In many cases though, one cannot justify a collection efficiency of over 80-90% by economics alone. But good employee and community relations may force systems to be designed for recovery efficiencies of 99% and over.

Tips for Cleaning

One way you can clean a dirty gas is by removing the cause of the dust and fumes. Briefly, either eliminate the source or reduce the contaminating matter.

A careful study of all the sources of dust and fumes should show the quantity and types of polluting agents. The engineer then decides what dust sources can be eliminated, what process changes can be made to reduce dust losses, and what raw material substitutions will improve operations.

An example of the last suggestion is the substitution of natural gas for oil or coal as a fuel, thereby eliminating fly ash and reducing SO_2, SO_3 and the stack plume (smoke trail).

Often faulty equipment is a

* Meet your authors on pp. 171, 172. This article is based on a paper presented at the San Francisco Technical Conference of the Air Pollution Control Association November 19, 1957.

Type of Plant—The Collectors Used—Dust Size and Concentration

	Dry Electrical Precipitators	Wet Electrical Precipitators	Baghouses	Reverse-Jet Filters	High Efficiency Cyclones	Scrubbers	Conditioning and Cooling Chambers*	Low Draft-Loss Cyclones	Low Draft-Loss Mechanical	Inlet Loading, Grains/Cu. Ft.	Percent of Particles Under 10 Microns
Aluminum											
Prebaked pot line	X	—	X G	—	X	X	—	—	—	0.2–0.5	25–35
Old-type Soderberg pot line	—	X	—	—	—	X	—	—	—	0.04–0.1	tar fog
New-type Soderberg pot line	—	X	—	—	X	X	—	—	—	0.2–0.5	tar fog
Electrode plant ventilation	X	—	—	—	—	—	—	—	—	0.1–1.0	—
Bauxite dryer	X	—	—	—	X	—	—	—	—	2–10	20–35
Alumina calcining	X	—	—	—	X	—	—	—	—	5–40	10–30
Cement											
Kilns	X	—	X G	—	X	—	—	—	—	1–15	40–50
Clinker coolers	—	—	—	—	X	—	—	X	X	0.2–1	5–20
Blending vents	—	—	X	X	—	—	—	—	—	—	—
Finish grinding	X	—	X	—	—	—	—	—	—	2–10	40–50
Rock and shale dryers	X	—	—	—	X	—	—	—	—	4–25	10–30
Chemical											
Acid manufacture	—	X	—	—	—	X	—	—	—	0.03–0.06	mist
Phosphate dryers	—	—	—	—	X	X	—	—	—	3–10	10–30
Electric phosphorus furnaces	X	—	—	—	—	—	—	—	—	0.2–2	95–99
Furnace carbon black plants	X A	—	X G	—	—	—	—	X	—	—	—
Iron and Steel											
Blast furnaces	—	X	—	—	—	X	—	—	X	0.1–0.5	95–99
Open hearth furnaces[3]	X	—	—	—	—	—	—	—	—	0.2–4	97–99
Sintering machines	X	—	—	—	X	—	—	—	X	2–5	10–50
Electric furnaces[9]	X	—	X	—	—	—	X	—	—	0–5	97–99
Scarfing machines	X	—	—	—	—	—	—	—	—	0–0.1	fume
Oxygen crucibles	X	—	—	—	—	X	X	—	—	0–5	97–99
Foundry cupolas[10, 11]	X	—	X	—	—	X	X	—	—	0.3–1	70–85
Non-Ferrous Smelters[12]											
Roasters	X	—	—	—	X	—	—	—	—	2–50	10–30
Reverberatories	X	—	—	—	—	—	—	—	—	2–5	50–60
Converters	X	—	—	—	X	—	X	—	—	0–10	10–50
Sintering machines	X	—	—	—	—	—	X	—	—	0.3–5	10–50
Blast furnaces	—	—	X	—	—	—	X	—	—	—	—
Power Generation Boilers[13]											
Pulverized coal fired	X	—	—	—	X	—	—	—	—	1–6	25–45
Cyclone furnace	X	—	—	—	X	—	—	—	—	0.25–0.75	80–85
Spreader stoker	—	—	—	—	X	—	—	—	—	5–15	10–15
Oil fired	—	—	—	—	X	—	—	—	X	0.02–0.07	99
Pulp and Paper											
Black liquor recovery boilers	X	—	—	—	—	X	—	—	—	1–5	fume
Reclaimed lime kilns	X	—	—	—	—	X	—	—	—	2–5	25–40
Hogged fuel boilers	—	—	—	—	X	—	—	X	X	2–10	5

* Used for conditioning and/or cooling gases ahead of precipitator or baghouse; G—Glass cloth bags (silicone-treated); A—Used as an agglomerator

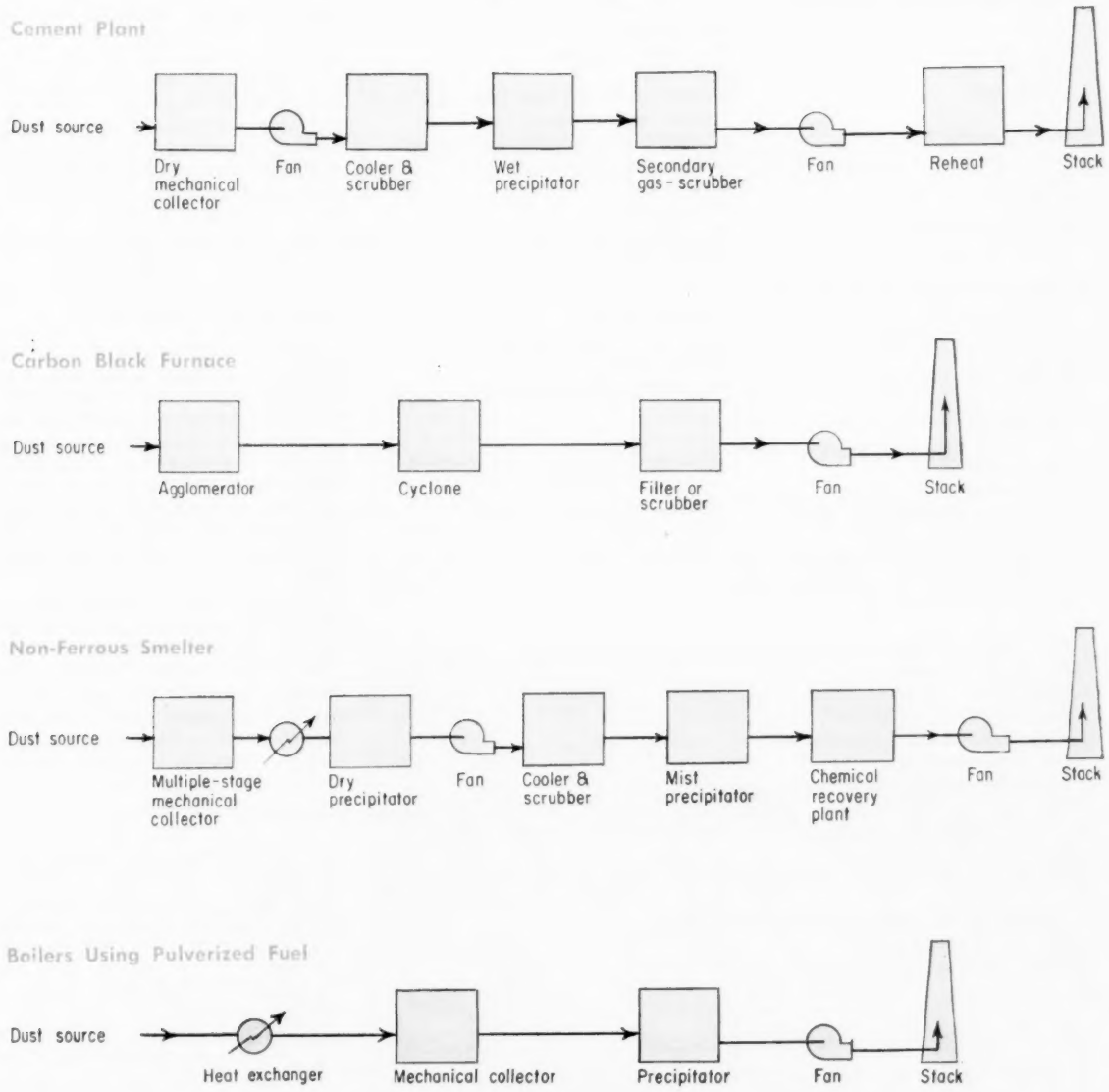
source of dust and fumes. In an electrical precipitator-collector, air infiltration may greatly reduce the unit's efficiency. Loose seal rings, cracks, and openings which leak air into the collector should be repaired.

If poor gas distribution is a cause of lowered efficiency of electrostatic and mechanical precipitators, one may provide turning vanes, perforated plates or baffles to improve operation.[8] Likewise, dust losses caused by improper dust recycling can be lowered by putting collected dust back in the system where it cannot be re-entrained readily.

When designing new plants, the engineer should remember that dust and fume control equipment is the final unit in the plant process system. If the plant capacity is increased, this equipment can become a bottleneck. Besides selecting modern recovery equipment, the engineer must allow space for such capacity increases that almost always come later.

Examples of ways to increase recovery capacity include: recycling part of the gas back to the process, modifying an existing scrubber to serve as a gas cooler for a new baghouse or a conditioning chamber for a new precipitator, and improving an existing precipitator by using a pre-cleaner, a voltage control, or automatic rapping.

Typical Plant Applications of Dust Collector Systems



Choosing Collectors

The table above is a general guide for choosing collectors. But it must be supplemented by economic and engineering studies before a final design is made.

In many cases more than one collector is shown for an application. A single unit may not do a thorough cleaning job, so that several types of collectors must be used in series.

The table also shows the ranges of inlet gas loadings, in grains of dust and fume per cubic foot of gas, and the relative sizes of the particles.

Flow diagrams of typical dust and fume recovery systems are shown above.

How to Disperse What's Left

At the final end of a dust and fume recovery system the waste gas and any remaining pollution material it may contain is diluted and dispersed to the atmosphere. The atmosphere can dilute enormous quantities of dust and fume. One of the earliest waste disposal devices was a very high stack.

The "smoke" from a stack is usually a layman's only view of a plant's air pollution record. Therefore combine several dust sources in a single stack to even out process variations and smoke output.

Factors Affecting Choice of Collectors

Nature of material collected

Dust only	Rock crushing
Fume only	Zinc oxide production
Dust and fume	Cement kiln
Soluble solids	Na_2SO_4 and Na_2CO_3 from paper mill black liquor recovery boiler
Noxious gases	SO_2 and SO_3 from coal or oil fired boiler
Tars or pitches	Carbon plant
Acid mist	Sulfuric acid
Corrosive	Wet fluorides
Flammable or explosive	Magnesium dust
Not free flowing	Furnace carbon black

Character of process operation

Uniform continuous	Aluminum pot line
Non-uniform continuous	Open hearth steel furnace
Batch	Gypsum kettles
Irregular intermittent	Steel plant scarfing machine

Technical Data

- Gas volume
- Gas temperature
- Inlet loading to collector
- Particle size distribution of solids[5]
- Specific gravity of solids
- Chemical composition of solids and gases
- Electrical resistivity of dust and/or fume
- Acid concentration or pH

Other engineering considerations

- Wet or dry collection
- Single or multiple units in series or parallel
- Available space and equipment arrangement
- Flues—including gas distribution, dampers, expansion joints and related facilities
- Fans with controls and drives
- Dust handling and disposal systems and accessories
- Labor saving auxiliaries and features, such as time cycle operation with filters, automatic voltage control and automatic rapping for electrical precipitators
- Instrumentation and controls
- Protective facilities, such as explosion diaphragms, traps, pressure relief devices and by-passes
- Permissible stack height and aircraft requirements
- Materials of construction
- Wind loads and seismic forces

Factors such as micrometeorology,[4] nearness of local airfields, economics, and the quantity and type of the stack gases influence the selection of stack height, size, outlet velocity and materials of construction.

Besides dispersing pollutants, a high stack provides some draft for maintaining flow through the whole system. Where high stacks can't be built, outlet gas velocity can be increased to 120-180 ft./sec. by placing nozzles in the top of the stack.

In some cases, one makes wind tunnel tests or field studies of the local topography and arrangement of surrounding structures. Particle concentrations of the gases, particle sizes, terminal velocity and gas temperatures all affect the final dilution of the stack gas stream in the air.

For coarse particles that fall out near the stack, cyclone-mechanical collectors are required.

Disposal of What's Collected

If a plant is fortunate enough to be able to reuse its collected dust and fume, there is no disposal problem. But, for most plants, the disposal of collected wastes is both difficult and expensive.

The experiences of the electric utility companies with large coal-burning stations illustrate the size and type of problem here.[6] Despite the raft of studies for using fly ash, there are still huge amounts of the waste regularly hauled off for landfill or dumped into the sea by the barge-load.

Waste disposal is an individual plant problem that is not easily generalized, but must be met and solved as the need arises. And correct solutions are always a must.

These Items Count, Too

Besides recovery, dispersion and disposal equipment, other vital parts of a dust and fume system must be selected with care and integrated into the whole cleaning process. For example, the distribution of gas and dust at the inlet must be uniform for efficient system operation. Thus flues should be carefully checked and designed before being built.[7]

All dust control systems have a fan placed as close as possible to the end of the system so that the cleanest gas passes through. The simplest possible fan and blades should be designed, and a 25-30% safety factor on both gas flow rate and pressure drop should be allowed.

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HOW TEMPERATURE AND COMPOSITION AFFECT . . .

Surface and Interfacial Tensions

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IN MANY of our engineering calculations we need not only a method for predicting the value of surface tension of a pure liquid, but also some methods that describe the temperature dependence of this property and the variation caused by composition changes in mixtures.

We have already discussed (*Chem. Eng.*, April 7, 1958, p. 146) an equation which, with sufficient density data, can be used accurately up to the critical point. This was Eq. (7), and its simplified form, Eq. (8), can be used in the common case of negligible vapor density.

However, in the higher-temperature ranges vapor density becomes a significant factor and Eq. (8) cannot be used. Similarly, sufficient refractive index data allow the use of Eq. (13), but to moderate presssures only.

In this article, we'll present two "primary" and two "secondary" methods of correlating the temperature dependence of surface tension.

Method 1—First, van der Waals'

Our most convenient expression, originally derived by van der Waals[30] and later confirmed by Ferguson[31] and Lövgren[32], is in this form:

$$\sigma = k(T_c - T)^m \qquad (17)$$

where k and m are constants.

This form is identical to the one we used earlier for the temperature dependence of latent heat of vaporization.[33] It meets all theoretical requirements, as it properly indicates that both σ and $d\sigma/dt$ become zero at T_c. van der Waals gave m as being equal to 1.5, which is far too large; the best average value is $m = 1.23$, but this is often rounded to 1.2. Our final equation, then, is:

$$\frac{\sigma_2}{\sigma_1} = \left(\frac{T_c - T_2}{T_c - T_1}\right)^{1.2} \qquad (18)$$

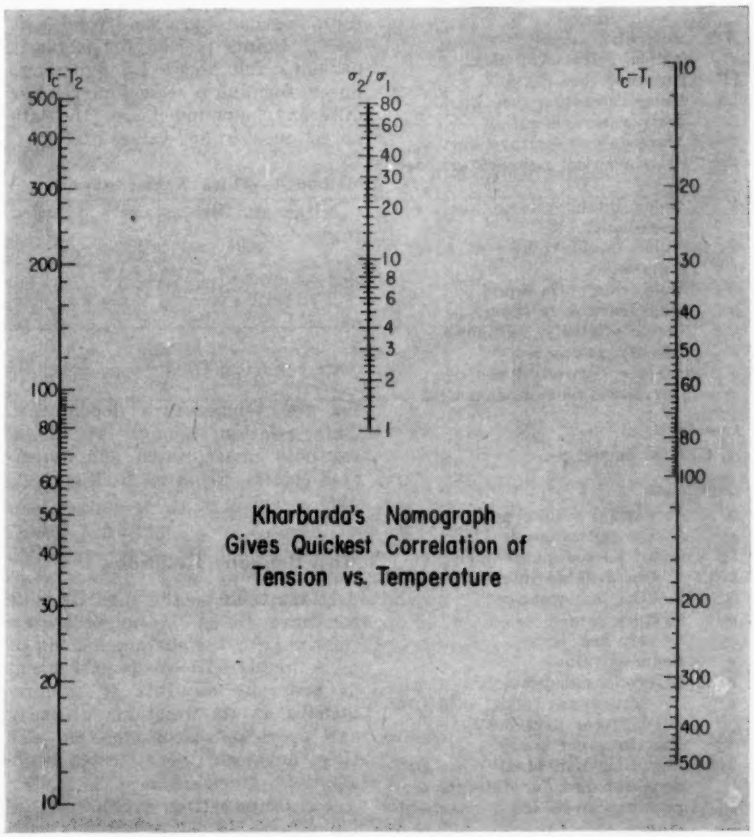
Kharbarda's nomograph[25] of Eq. (18) is given below. The error is only a few percent over a moderate temperature range. However, since the vapor density was assumed as small compared to liquid density in the derivation, Eq. (18) sometimes loses accuracy near the critical point.

For associated liquids, m is greater than 1.2, since degree of association decreases with rising temperature. The equation is applicable to mixtures, if you use Kay's rule to evaluate the pseudo-critical temperature, T_c':

$$T_c' = T_{c1}x_1 + T_{c2}x_2 + \cdots \qquad (19)$$

Method 2—Reference Substances

Carr and Wolczynski[34] were probably the first to suggest a reference-substance type plot for cor-



* Mr. Gambill is now with the Union Carbide Nuclear Co., Oak Ridge, Tenn. To meet your author see *Chem. Eng.*, Feb. 10, 1958, p. 173.

relating surface tensions. They proposed that:

$$(T_2 - T_1)/(T_{R2} - T_{R1}) = K \quad (20)$$

where K is a constant.

If we want to extrapolate two surface tensions, known at T_2 and T_1 for a given liquid, the procedure is to select a similar reference liquid whose surface tension over a range of temperatures is known; and then to plot, on rectangular coordinates, temperature of a given liquid as ordinate vs. temperature *for equal surface tension* of the reference substance plotted as the abscissa.

The slope of the straight line will be K. We could use T_c and T_{Rc} for T_2 and T_{R2}, but Othmer's procedures, described below, are better near the critical point. Use of Eq. (20) is accurate over only moderate temperature ranges, since flat curves instead of straight lines are obtained for large values of $(T_2 - T_1)$.

A reference-substance approach by Othmer, et al.,[25] is superior to that given above and is recommended for broad extrapolations or interpolations. Othmer recommended making a log-log plot of σ vs. $(T_c - T)$, which was dubbed the "critical difference temperature," T_D. Barring chemical changes, this procedure produces straight lines over the complete liquid range of the compound. For 28 tested liquids, accuracy was excellent.

An alternative, but less convenient procedure, as proposed by Othmer, is to make a log-log plot of known-liquid surface tensions vs. those of a reference liquid at equal values of $(T_c - T)$. Though such a plot will tend to compensate for any slight deviations that may exist in a direct σ vs. $(T_c - T)$ plot, the advantage is quite small.

Nomenclature

E_s	Surface energy, dynes/cm.
I	Viscosity constitutional constant.
L_v	Latent heat of vaporization at t_b, cal./gram.
M	Molecular weight.
n	Optical refractive index.
[P]	Parachor (see Eq. 6).
[R_D]	Molar refraction (see Eq. 12).
t	Temperature, deg. C.
T	Absolute temperature, deg. K.
T_c'	Pseudocritical temperature, deg. K.
V	Molar liquid volume at t, cc./gram-mole.
V_m	Molar liquid volume at t_b, cc./gram-mole.
x	Mole fraction in liquid.
y	Mole fraction in vapor.
μ	Liquid viscosity, millipoises.
ρ	Density, grams/cc.
σ	Surface tension, dynes/cm.
σ_i	Interfacial tension, dynes/cm.

Constants

A, C, k, K, m and p

Subscripts

b	At normal boiling point.
c	At the critical point.
D	Based on sodium D line.
i	At liquid-liquid interface.
l	For the liquid phase.
m	Mixture value.
o	At zero deg. K.
r	Reduced value.
R	Reference substance.
s	At saturation; also, values of Sugden (for parachor).
V	For the vapor phase.
1, 2	Denoting individual pure components; also, for different temperature levels for a given substance.

Method 3—Katz & Saltman

Katz and Saltman[35] plotted σ vs. T_r on rectangular coordinates to obtain a single correlation curve for 7 normal paraffins from 0 C. to T_c. Points plotted for isomeric paraffins fell about 1.2 dynes/cm. lower, forming a second curve. For different compound classes, the data spread most at low values of T_r.

Method 4—Mitra & Srivastava

Mitar and Srivastava[36] proposed that:

$$\log \frac{\sigma_2}{\sigma_1} = kT_2^p \left(\frac{T_1 - T_2}{T_2} \right)$$

or,

$$\log \frac{\sigma_2}{\sigma_1} = K(\log T_2)^m \left(\frac{T_1 - T_2}{T_2} \right) \quad (21)$$

for the temperature dependence. This relation, though promising for both unassociated and associated liquids, requires further testing.

Miscellaneous Relations

In the table on the opposite page we have listed 11 miscellaneous relations for the surface tension of pure liquids. These are either not as generally accurate or comprehensive as the relations given in our previous discussions, or else they have not been tested sufficiently.

Two interesting exceptions are No. 9 and No. 11, which are relations for calculating the hypothetical surface tension at 0 K., σ_o.

Methods for Mixtures

Most organic substances, when dissolved in a highly polar solvent such as water, exhibit surface activity and are strongly adsorbed at the free surface. The surface tension in this case will usually decrease extremely rapidly with first solute addition, and then increase slowly with increasing solute concentration.

When rather high concentrations are reached, there is usually little difference between bulk and surface concentrations. Saturated water solutions of the high monobasic acids, alcohols, esters, etc., have surface tensions which are generally only a few dynes/cm. higher than those of these pure solutes themselves.

Gibbs' thermodynamic relation for surface absorption in dilute solutions is rigorous and has been verified, but use of his equation requires knowledge of the rate of change of surface tension with concentration to obtain the surface-bulk concentration difference, or vice versa.

Other than these rules-of-thumb, there is little available at present to permit reliable calculations of the surface tensions of such organic-water solutions. Meissner and Michaels[37], using an empirical relationship derived earlier by Szyrzkowski,[38] determined constants which enable estimates to be made for dilute water solutions of a variety of organic compounds. At 20 C., they claim an accuracy of about 3%.

The same authors also present two graphs which can be used for higher-concentration water solutions of monobasic acids and monohydric alcohols (at 20C.). For these special cases, the reader is referred to the Meissner-Michaels article.[37]

Whereas organic additives generally reduce water's surface tension sharply, electrolytes usually increase it—the surface being solvent, rather than solute rich. This increase, however, is quite small (3 dynes/cm. is the largest known to this writer, e. g.).

Though the organic-water case is not amenable to generalized, reliable calculation at present, we are in much better shape when it

Some Miscellaneous Methods for Estimating Surface Tensions

No.	Proponent	Relation or Indication of Content	Reference
1.	Auerbach	$\sigma = (6.3 \times 10^{-4})\rho_l U_l^{1.5}$ where σ = dynes/cm.; ρ_l = grams/ml.; and U_l is the sonic velocity in cm./sec.	*Experientia*, **4**, p. 473 (1948).
2.	Wiener	$\sigma = 14.6 \log (n - 3) + 11.52$ where σ = dynes/cm.; n = number of carbon atoms/molecule. For normal alkanes at 20 C.: empirical, but accurate. About $\frac{1}{4}$% avg. dev.	*J. Phys. Chem.*, **52**, pp. 1,082–1,089 (1948).
3.	Sibaiya and Rao	A theory of surface tension for liquids at the solidification temperature.	*Indian J. Phys.*, **13**, p. 293 (1934).
4.	Pettinelli	$\sigma(T_c - T)(M/\rho_l)^{2/3} = \text{const.} \approx 0.20$ Similar to Katayama equation (see text).	*J. de Phys.*, **1**, p. 594 (1902).
5.	De Wijs	$\sigma = L_V/c(T_c - T)^q$ where c and q are constants; q is negative. Good agreement with experimental data.	*J. Phys. Chem.*, **51**, p. 747 (1947).
6.	De Corvalho	$\sigma \approx 1.085 T_b \left[\frac{\rho_l - \rho_g}{M}\right]^{2/3}$ Units: dynes/cm.; deg. K.; and gram-moles/cc.	*Nature*, **160**, p. 370 (1947).
7.	Goldhammer	$\sigma = A(\rho_c/M)^{2/3}(1 - T_r)^{5/4} T_c$	*Z. phys. Chem.*, **71**, p. 601 (1910).
8.	Herz	$\sigma^{1/3}/(\rho_l - p_g) = c$ $\sigma^{0.133}/(\rho_c - \rho_g) = c'$ $\sigma^{0.125}/(M/\rho_l)^{2/3} = c''$ where c, c' and c'' are constants.	*Z. anorg. Chem.*, **175**, p. 277 (1928); **203**, p. 271 (1932).
9.	Herz	$\sigma_o = K(T_c - 6)/(M/\rho_c)^{2/3}$; $\sigma_o/\sigma_b \approx 3.5$	*Z. anorg. Chem.*, **129**, p. 265 (1923).
10.	Lorenz and Herz	$\sigma_b/\sigma_m \approx 0.578$ where subscript m denotes "at melting point." $\frac{\sigma_b}{\sigma_m} = \left[\left(1 - \frac{T_b}{T_c}\right)\Big/\left(1 - \frac{T_m}{T_c}\right)\right]\left(\frac{V_m}{V_c}\right)^{2/3}$	*Z. anorg. Chem.*, **120**, p. 320 (1922).
11.	Lövgren	$\sigma_o = [(k/T_c)^6/[\mathrm{P}]^4]^{0.2}$ where k is nearly equal to 2.12.	*Svensk. Kem. Tid.*, **53**, p. 359 (1941).

comes to organic-organic liquid mixtures. The following four methods are all for this common case and are all—within their defined limits—usually quite satisfactory. Three are for low-pressure conditions only (T not near T_c), but one is apparently accurate over the whole liquid range, though more involved.

Method 1—Weinaug and Katz

Weinaug and Katz[80] and Reno and Katz[40] developed a correlation based on some earlier work of Fowler[11] which quite accurately represents experimental surface tensions for three binaries to 200 F. and 100 atm.

Average deviation for the methane-propane system, for example, is only 0.09 dyne/cm. (observed minus calculated). Their relation:

$$\sigma_m^{0.25} = [\mathrm{P}]_1\left(\frac{\rho_l x_1}{M_l} - \frac{\rho_v y_1}{M_v}\right) + [\mathrm{P}]_2\left(\frac{\rho_l x_2}{M_l} - \frac{\rho_v y_2}{M_v}\right) + \cdots \quad (22)$$

Eq. (22) is recommended for calculating mixture surface tensions under high-pressure conditions. The three relations discussed below are simpler and are adequate for low pressures.

Weinaug and Katz also tried the Katz and Saltman graphical correlation[25] unsuccessfully, finding quite a broad data scatter for mixtures.

Method 2—Neglect Vapor Density

For negligible vapor density, Meissner and Michaels[37] found that Eq. (13) could be used with accuracy for mixtures if molar averages are taken for [P], [R_D] and n:

$$\sigma_m = \left(\frac{[P]_m}{[R_D]_m} \times \frac{n_m^2 - 1}{n_m^2 + 2} \right)^4 \quad (23)$$

$$[P]_m = [P]_1 x_1 + [P]_2 x_2 \cdots \quad (23a)$$

and $[R_D]_m$ and n_m are evaluated by equations in the form of Eq. (23a).

Eq. (23a) has been verified by the work of Hammick and Andrew.[41] The expression for mixture molar refraction is adequate for mixtures of components that are not very different in degree of polarity or association. The results for mixture refractive index exhibit significant deviations only for mixtures whose pure components possess large differences of refractive index.

Eq. (23) was found to represent surface tension data for 19 binary organic mixtures of 65 different compositions (0 to 1.0 mole fraction) with average and maximum deviations of 3.4 and 7.0%, respectively. Molecular association doesn't seem to invalidate the method for organic mixtures, and it holds true for many mixtures of different chemical types.

Caution should be used, however, in applying this method to mixtures whose components are very different in polarity. Organic-water mixtures constitute only an extreme example of deviations arising from polarity differences, and some organic-organic mixtures show the same behavior, though to a lesser degree.

This method was also checked for ternary mixtures by Michaels, Alexander and Becker,[42] who found average and maximum deviations of 5.8% and 19.2% for 83 compositions of three ternaries. To provide an adequate test, ternaries with large pure-component surface tension differences were chosen. The shapes of the calculated surface tension-composition curves were quite similar to those of the experimental curves, even when the actual deviations were largest.

Using Eq. (23) is generally more accurate than the use of simple linear interpolation of pure-component surface tensions.

Method 3—Hammick and Andrew

Hammick and Andrew[41] found good agreement for nonassociated, nonpolar liquid mixtures at low pressures (not near the critical point) with this expression, in which ρ_v is neglected:

$$\sigma_m = \left[[P]_m \frac{\rho_l}{M_l} \right]^4 \quad (24)$$

Using Sugden's parachor values, one may estimate σ for nonassociated mixtures within about ½% error (1% max.); and even for associated mixtures, the writer found an average error of only about 3.5%.

Method 4—Stakhorsky Relation

Stakhorsky[43] proposed a simple correlation, later investigated by Bowden and Butler,[44] which is:

$$\sigma_m = \frac{\sigma_1 \sigma_2}{\sigma_1 x_1 + \sigma_2 x_2} \quad (25)$$

Stakhorsky derived this relation by assuming that surface tension is proportional to internal pressure. The equation is valid only at low pressure; and for eight solutions checked by the writer, avg. and max. deviations were about 1% and 5%, respectively.

Except for quick answers, the three methods discussed above are probably better.

Now, Interfacial Tensions

For any pair of completely soluble or miscible liquids, the interfacial tension is, of course, zero. For partially miscible or immiscible liquids, however, there exists a liquid-liquid interface or surface of phase separation, also called a dimeric interface.

Since the mutual attraction of unlike molecules at the interface reduces the large unbalance of forces existing on the molecules at a free surface, the interfacial tension is less than the larger of the surface tensions of the component liquids.

The range of values of interfacial tension is rather broad; for organics with water at 20 C., typical low and high values are 1.66 dynes/cm. for dipropylamine and 51.1 dynes/cm. for n-hexane. For water-mercury at 20 C., $\sigma_i = 375$ dynes/cm. For organics with mercury at 20 C., most values fall within the range of 300-380 dynes/cm.

G. N. Antonoff proposed[45] the only useful estimation rule for σ_i. This rule states that for two saturated liquid layers in equilibrium, the interfacial tension is equal to the difference between the individual surface tensions of the two mutually saturated phases against a common vapor or gas:

$$\sigma_i = \sigma_{1,2} - \sigma_{2,2} \quad (26)$$

Key to successful interpretation of this rule are the words "mutually saturated phases." Neglect of this qualifying phrase has apparently created considerable confusion concerning the validity of Antonoff's rule.

If the difference is taken between pure-component surface tensions, the rule proves quite inaccurate unless the components are totally immiscible; in which case pure-component and saturated-phase values are, of course, identical. A study made by the writer showed that for 11 organic liquids with water at 20 C., the average error associated with Eq. (26) when using pure-component surface tensions was 125%.

If however, the rule is properly applied by taking the difference of saturated-phase surface tensions, the accuracy improves greatly. Reynolds found[46] an average error of only 3.3% for eight organic liquid-water systems in the 17- to 26-C. range; min. error was 0% and max. was 14.2%. Reynolds' data also indicate that the greatest errors are encountered with systems having small interfacial tensions. This disagrees with the studies of Fuchs[47] and of Murphy, Lastovica and Fallis[48], whose data indicate smaller percentage errors for smaller interfacial tensions.

The conclusion here is apparently uncertain at this time. More work is required on interfacial tension.

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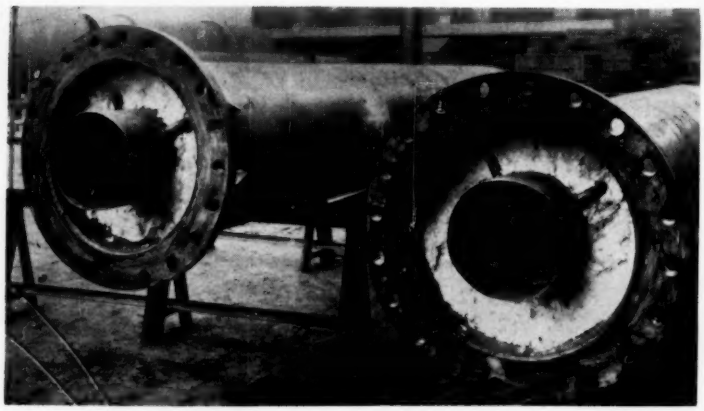
PRACTICE . . .

DESIGN NOTEBOOK EDITED BY T. R. OLIVE



Inside Insulation Saves Cost

This design idea can save many dollars worth of costly alloys in some high-temperature, high-pressure equipment.

Robert F. Benenati
Polytechnic Institute of Brooklyn, Brooklyn, N. Y.

Illustrated above is a cost-saving idea which has been practiced for some time in Europe but has not, I believe, been used widely in the United States. It consists in putting some or all of the insulation of hot process equipment *inside* the equipment where it will reduce the metal wall temperature.

In handling high-temperature, high-pressure gases this trick effects considerable savings by increasing the allowable stress in the vessel wall.

In the illustration the outer pipe wall contains the pressure. The insulation is held in place by a thin-walled tube which also lines the insulation to prevent erosion as well as gross contamination of the gas stream by the insulation.

Perforating the liner or leaving its sections loosely joined will equalize pressure on both sides of the tube. The liner must withstand the high temperature, but it can be very thin, while the outer vessel wall must withstand the full pressure but at a lower temperature and so can be a low alloy steel.

As an example of the advantages of this technique, consider a 12-in. O.D. pipe carrying air at 1,400 F. and 850 psia. The outside temperature is to be limited to 150 F. If the insulation has a thermal conductivity of 0.3 Btu./(Hr., sq. ft., °F./in.), then 2 in. of insulation will be needed.

Without insulation a 2-in. pipe wall would be required if the material were 316 stainless. In this case the pipe I.D. would be 8 in. However, if we use a thin-walled 8-in. tube with 2 in. of insulation between it and a 12-in. outer pipe, then the pipe wall temperature will be at only 150 F.

Hence, carbon steel can be used and a wall thickness of 0.3 in. will hold the pressure.

With "inside-out" insulation the stainless steel can be replaced with only 17.5% as much carbon steel. Furthermore, the insulation weight is thus reduced to 71% of the amount needed if exterior insulation were used.

Added to the weight saving, the inside-out insulation simplifies many thermal stress and thermal expansion problems met with outside insulation.

Get Relative Volatility For Binary Solutions

Robert F. Sweeny
Chemical Engineer
Applied Science Laboratories, Inc.
State College, Pa.

By means of the simple equations given here you can quickly calculate a relative volatility for an ideal binary solution. The only data needed are the boiling points of the two pure substances at the pressure of interest and the heats of vaporization. The method assumes that Raoult's and Dalton's laws apply and that the heats of vaporization do not vary radically with the temperature.

First, calculate y_A from the following equation, using trial and error. A convenient initial trial value of y_A is between 0.5 and 0.7:

$$y_A = e^C(1 - y_A)^D \qquad (1)$$

where

$$C = H_A(T_B - T_A)/RT_AT_B$$

and

$$D = H_A/H_B$$

Then, when y_A is known, the

Nomenclature

	Exp. $= H_A(T_B - T_A)/RT_AT_B$.
D	Exponent $= H_A/H_B$.
e	Base of natural logarithms.
H	Heat of vaporization, cal./gm. mole.
R	Gas constant $= 1.99$.
T	Boiling point at pressure of interest, °K.
y_A	Vapor composition at liquid composition of 0.5 mole fraction.
α	Relative volatility.

Subscripts

A	Refers to more volatile liquid.
B	Refers to less volatile liquid.

DAY

EQUIPMENT FOR INDUSTRY

LOW COST, EFFICIENT

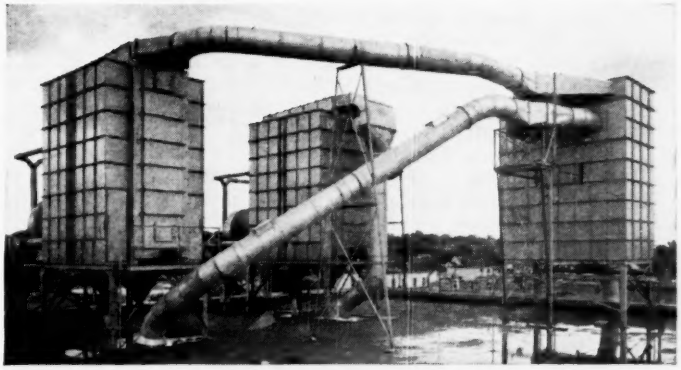
Dust Control

More and more leading companies are depending on DAY for complete dust control service. DAY can recommend and engineer a complete dust control system for the needs of any industrial plant.

Photo at right illustrates a DAY Pneumatic Bag Handling System. The empty bags (containing a residue of carbon black) are carried by air to the bag trap (unit on right side of picture). The air is then cleaned in the DAY "AC"* filter at the left in the picture. The other DAY "AC" filter (center background) is on a separate dust control system.

For complete information write for Bulletin F75.

* Licensed by H. J. Hersey, Jr.



Type "RJ"* Dust Filter – Highly efficient, combination cyclone and filter. Write for Bulletin G-579

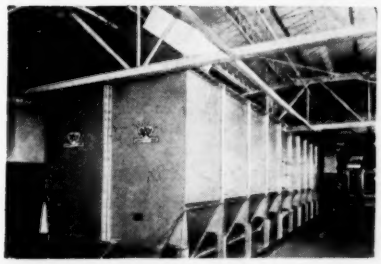
"HV" Dust Separator – A heavy gauge, welded, highly efficient centrifugal dust separator. Write for Bulletin 576.

Type "G" Fans – Statically and dynamically balanced; designed principally for dust control applications. Write for Bulletin 471.

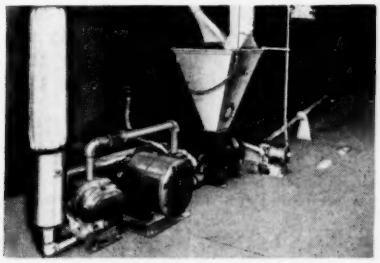
Dual-Clone Dust Separator – Exclusive design gives high efficiency at low resistance. Write for Bulletin 573.

Unit Dust Controllers – Complete, low cost unit combines high efficiency of Dual-Clone and Exhauster. Write for Bulletin 510.

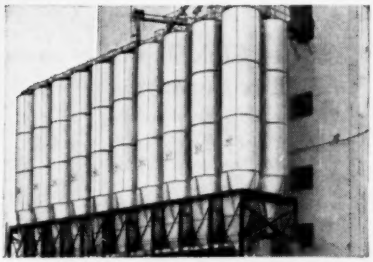
Money-Saving Bulk Material Storage and Handling



A two-section DAY horizontal tank installed in a Canadian plant. Pneumatically loaded and mechanically unloaded. Note air relief on top of tank.



DAY pneumatic conveying systems improve plant efficiency. Installation pictured above required two pumps in series because of long (250 feet) run.



Twenty DAY tanks (above) installed at a large Midwest plant. Tanks serve packaging line as well as truck, railcar loading operation. Each tank holds approximately 20 tons of product.

What's Behind the Swing to DAY Bulk Material Storage and Handling? Many plants with DAY equipment save up to 35¢ on every 100 pounds of material handled. DAY equipment is also safer, cleaner and more efficient than manual material handling. DAY bulk equipment can be installed anywhere. It is completely sanitary and weather-proof. Find out how much money your plant can save when it is equipped with DAY products for handling and storing bulk materials. For latest information write toDAY for Bulletin 574.

For DAY office nearest you refer to our advertisement in Chemical Engineering Catalog.

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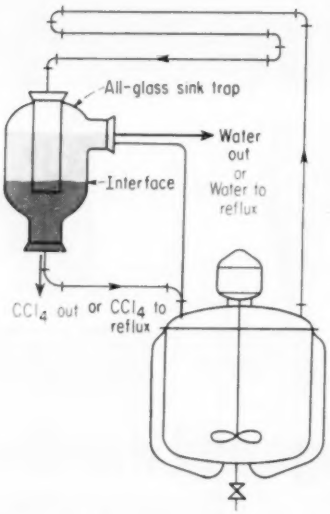
relative volatility α may be calculated from:

$$\alpha = y_A/(1 - y_A) \quad (2)$$

In the special case where $H_A = H_B$, the equations simplify to:

$$\alpha = e^C \quad (3)$$

As an example of the results given by this method, the relative volatility of benzene-toluene at 760 mm. Hg is found to be 2.530 by using Eqs. (1) and (2), or 2.286 by using Eq. (3). The true value, calculated as the ratio of the vapor pressures, is 2.496 at a liquid composition of 0.5 mole fraction.

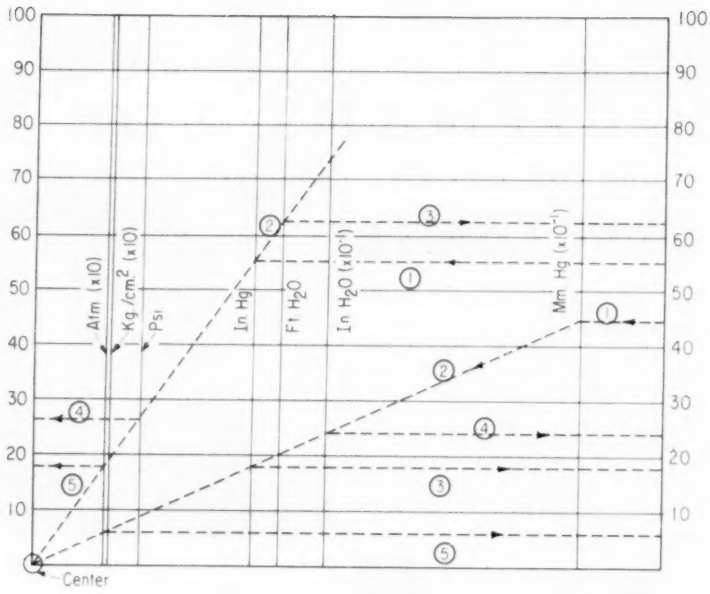


Glass Sink Trap Becomes Reflux Separator

Robert A. Snedeker
E. I. duPont de Nemours & Co.
Photo Products Dept.
Parlin, N. J.

Here is a way to separate liquid reflux to a still when the condensate is a two-phase immiscible system such as water-carbon tetrachloride or water-benzene. The Pyrex glass cap-type sink trap is readily adapted to this use. Depending on how it is connected, it can be used to reflux the heavy phase (black lines) or light phase (colored lines).

This makes it possible to use standard equipment rather than a custom-made separator in setting up a steam distillation for solvent removal or an azeotropic distillation to remove water.



This Chart Converts Pressure Units

Jerome A. Seiner*
Chemical Corps Phosphate Development Wks., Sheffield, Ala.

The chart above is a handy way to convert from one system of pressure units to another. The units included are: Atm.; Kg./sq. cm.; Psi.; In. Hg; Ft. H_2O; In. H_2O; and Mm. Hg.

Enter either of the vertical scales horizontally at the numerical value of the quantity to be converted and move to the vertical line labeled with the original units. From the intersection draw a line downward to the left through the point marked "Center." The intersection of this line with any of the vertical lines marks the converted value for those units.

For example, following the numbered lines, 455 mm. Hg = 17.9 in. Hg = 244 in. H_2O = 0.62 kg./sq. cm. Also, 55.5 in. Hg = 62.7 ft. H_2O = 27.2 psi. = 1.85 atm.

* Present address: Pittsburgh Plate Glass Co., Paint Div., Springdale, Pa.

NEXT ISSUE: Watch for April Winner Announcement

★How Readers Can Win

$50 Prize for a Good Idea—Until further notice the Editors of *Chemical Engineering* will award $50 each four weeks to the author of the best short article received during that period and accepted for Plant or Design Notebook.

Each period's winner will be announced in the second following issue and published in the third or fourth following issue.

$100 Annual Prize—At the end of each year the period winners will be rejudged and the year's best awarded an additional $100 prize.

How to Enter Contest—Any reader (except a McGraw-Hill employee) may submit as many contest entries as he wishes. Acceptable material must be previously unpublished and should be short, preferably not over 500 words, but illustrated if possible. Acceptable non-winning articles will be published at space rates ($10 minimum).

Articles should interest chemical engineers in development, design or production. They may deal with useful methods, data, calculations. Address Plant & Design Notebooks, *Chemical Engineering*, 330 W. 42nd St., New York 36, N. Y.

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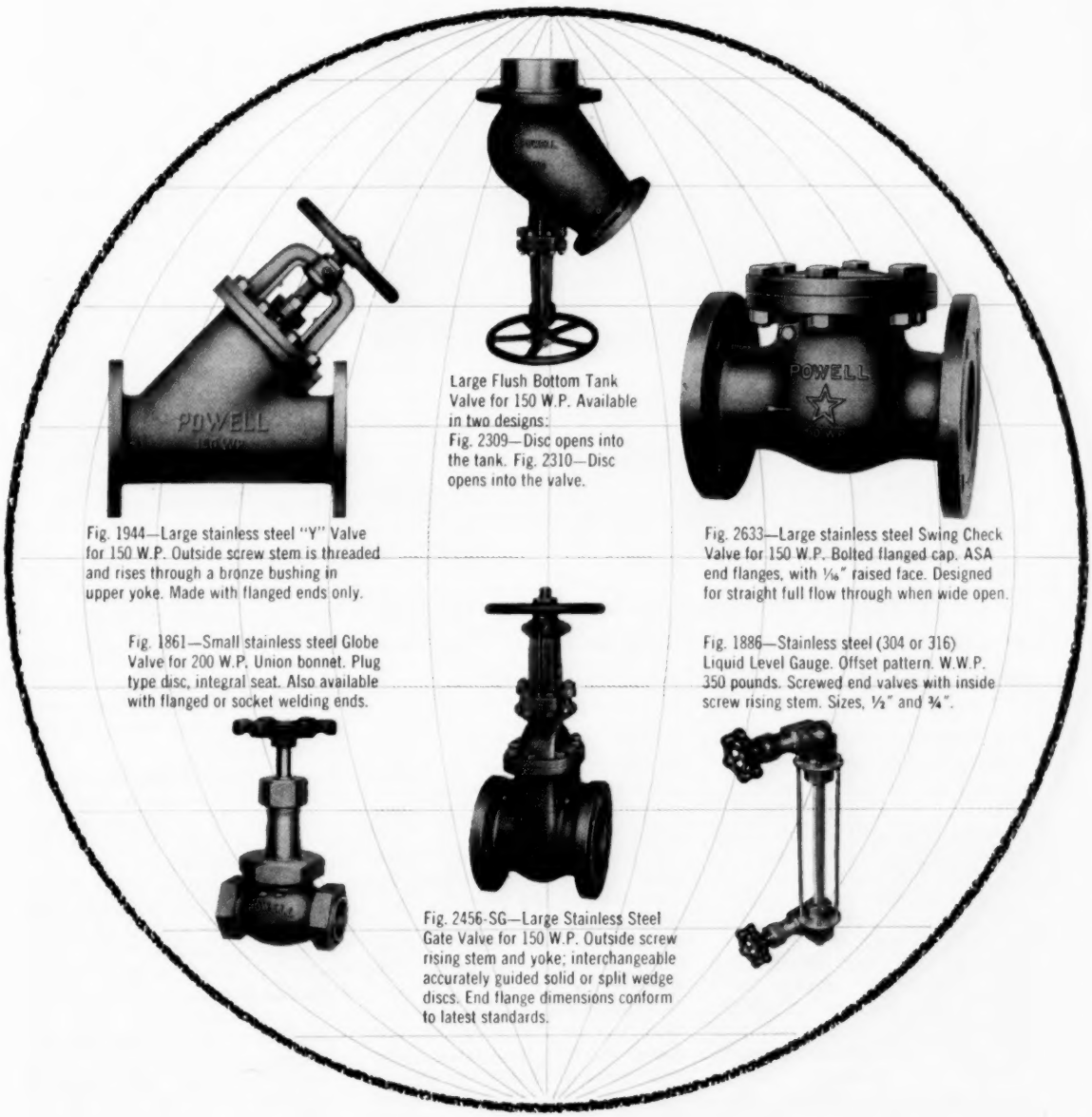

Large Flush Bottom Tank Valve for 150 W.P. Available in two designs: Fig. 2309—Disc opens into the tank. Fig. 2310—Disc opens into the valve.

Fig. 1944—Large stainless steel "Y" Valve for 150 W.P. Outside screw stem is threaded and rises through a bronze bushing in upper yoke. Made with flanged ends only.

Fig. 2633—Large stainless steel Swing Check Valve for 150 W.P. Bolted flanged cap. ASA end flanges, with 1/16" raised face. Designed for straight full flow through when wide open.

Fig. 1861—Small stainless steel Globe Valve for 200 W.P. Union bonnet. Plug type disc, integral seat. Also available with flanged or socket welding ends.

Fig. 1886—Stainless steel (304 or 316) Liquid Level Gauge. Offset pattern. W.W.P. 350 pounds. Screwed end valves with inside screw rising stem. Sizes, ½" and ¾".

Fig. 2456-SG—Large Stainless Steel Gate Valve for 150 W.P. Outside screw rising stem and yoke; interchangeable accurately guided solid or split wedge discs. End flange dimensions conform to latest standards.

A solution for every kind of flow control problem is as near as your local Powell distributor. Powell valves are designed and engineered in the largest variety of metals and alloys, to handle any medium, every flow control requirement. There are Powell distributors in all principal cities. Or, if yours is a special engineering problem, write to:

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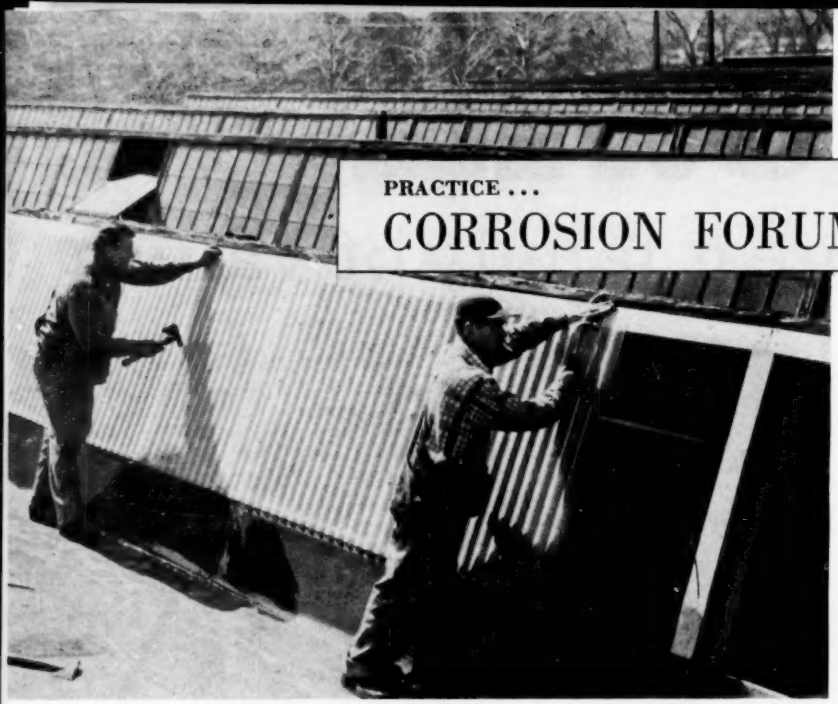


PRACTICE . . .

CORROSION FORUM

EDITED BY R. B. NORDEN

PLASTIC PANEL COVERINGS:

Handle Tough Plant Conditions

Translucent reinforced plastic panels offer high strength, corrosion resistance and low cost. They are getting a big play in chemical plant construction.

P. N. Cheremisinoff, Alsynite Co. of America, Paterson, N. J.*

Fiberglass reinforced plastic panels could easily be the steel of tomorrow. This material is stronger than corrugated iron, lighter than aluminum and it transmits diffused light.

Metal, asbestos or glass panels have their place as coverings (industrial daylighting) for plant buildings. But translucent fiberglass panels are moving rapidly into chemical plant construction, particularly for processes where sudden temperature changes occur (tapping a phosphorus furnace) or where corrosive fumes exist.

These panels present no breakage problem, no window sashes are required, color can be built in, they call for little maintenance and they can be used in conjunction with standard covering materials.

*Meet your author on page 171.

▶ **Critical Properties** — Fiberglass reinforced sheeting is a laminate of glass fibers and polyester resins.

Polyester resins belong to the class of thermosetting plastics. Once formed and cured by heat, they cannot be reformed or deformed by heat and/or pressure, without rupturing the material itself.

Approximate composition of a fiberglass-reinforced translucent panel is 75% polyester resin reinforced with 25% by weight fiberglass. The glass mat itself consists of a random arrangement of nonwoven lengths of glass fibers, which form a highly porous, felt-like material.

Important properties of the most commonly used industrial weight panels are shown in the table (note corrugations).

▶ **Carrying Its Load**—Experience shows that load strength, maximum span and deflection present the most difficult problems in connection with reinforced plastic sheets.

Panel strength is directly proportional to the glass content—0.090-in. thick sheets will be 50% stronger than 0.060-in. thick sheets. Deflection under the same load will vary with panel weight—the heavier panels will take a heavier load. This dependence, at present, cannot be expressed mathematically.

Recommended spans for various panels exist. For example, spans for 0.060-in. panels will run from 2-ft. for a 1¼-in. corrugation to 4½-ft. for a 4.2-in. corrugation.

In such installations stiffness is a controlling factor. The deeper the corrugation the greater the stiffness and the lower the deflection or sag.

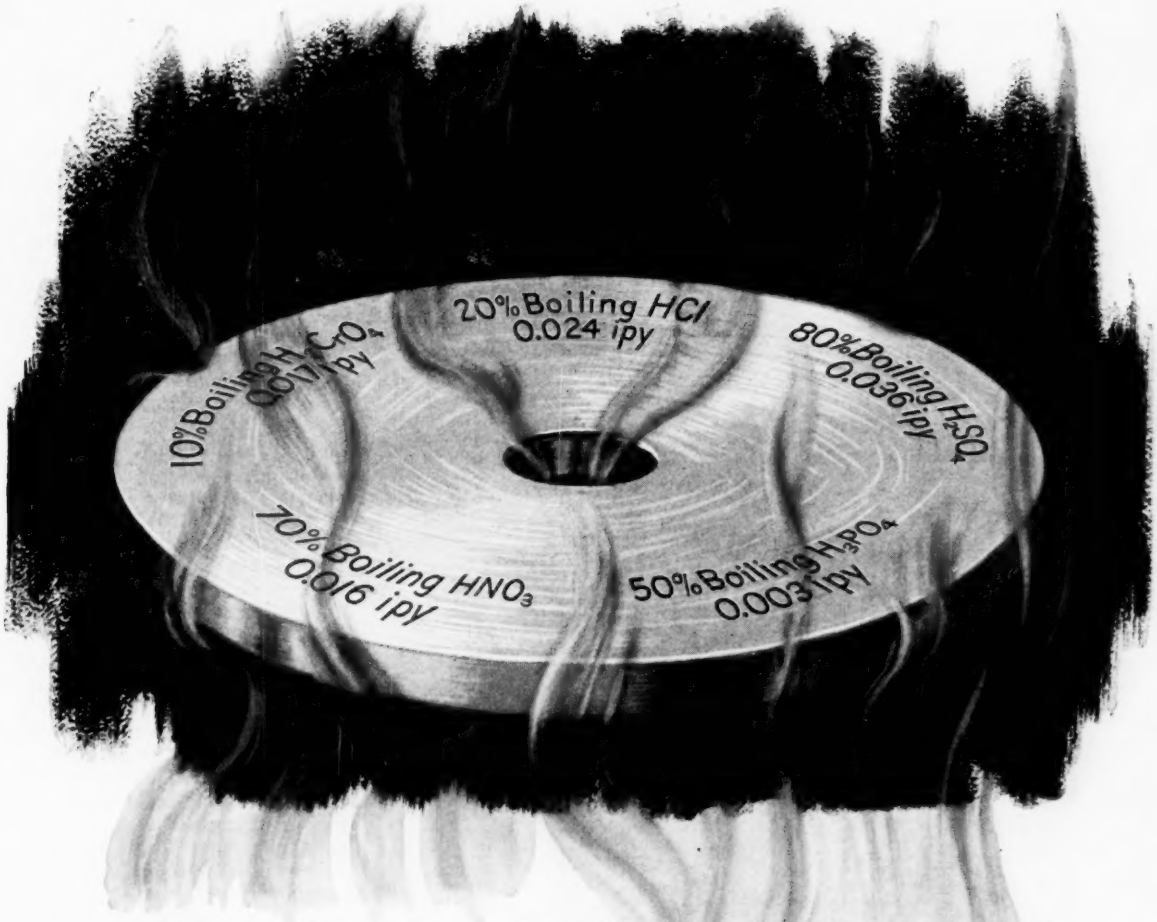
Greater thicknesses also allow for greater spans, but normally, where exceptional strength is not required, it will be more economical to use additional supporting members and a thinner sheet.

▶ **Good Chemical Resistance**—A good indication of the chemical resistance of fiberglass polyester plastic sheeting is given in the corrosion table.

Values reported are a result of a series of tests carried out in accordance with ASTM test procedure D543-52T. In this test, specimens are immersed in the chemical reagent for a period of seven days, and the changes in weight, dimensional stability, and appearance noted.

Test samples are removed from the chemical and allowed to recondition for seven days. Changes in weight, dimensions and appearance are noted.

Unlike metals, which are attacked by chemicals at a constant rate, fiberglass reinforced plastics are usually attacked very rapidly or not at all. Therefor, if the plastic sheet is not affected in seven days, as in



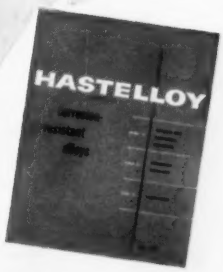
Corrosion from boiling mineral acids?

TEST "HAYNES" ALLOYS

The low corrosion rates on the test specimen indicate the remarkable resistance of HAYNES alloys to mineral acids . . . even at the boiling point. These alloys reduce corrosion damage and product contamination from mineral acids at all temperatures. You will find, too, that they have outstanding resistance to chlorides, halogens, mixed acids, and alkalies.

The penetration rates shown on the disks were obtained as a result of laboratory tests. How closely will they match up with data obtained under actual operating conditions? You can find out for sure by testing them.

We'll be glad to send you samples. But to narrow down the number, we suggest you send us a letter outlining your corrosion problem. For full information on HAYNES corrosion-resistant alloys, their properties, forms, the corrosives they will resist, ask for a copy of our 104-page book.



HAYNES ALLOYS

HAYNES STELLITE COMPANY

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Glass-Reinforced Polyester Panels Resist Chemicals

	Weight Increase, 7-Day Immersion	Weight Increase, 7-Day Standing After Immersion	Appearance Change*
Distilled water	0.59%	0.19%	No change
Ethyl alcohol, 95%	0.92	0.18	Some fibers showing
Sulfuric acid, 3%	0.43	0.08	Some fibers showing
Sulfuric acid, 30%	0.28	0.13	Some fibers showing
Sodium hydroxide, 1%	0.63	0.12	Few fibers showing
Sodium hydroxide, 10%	0.26	0.17	Some fibers exposed reduction in gloss
Toluene	0.14	0.13	Few fibers showing
Sodium chloride, 1%	0.43	0.18	No change
Hydrochloric acid, 10%	0.24	0.01	Few fibers showing
Chlorine gas	No change	No change	No change
Hydrogen sulfide	No change	No change	No change

* Dimensions remain unchanged in all cases.

Important Properties of Plastic Panels

	Weight: 6 oz./sq. ft.	Weight: 8 oz./sq. ft.	Weight: 11 oz./sq. ft.
Thickness, in.	0.045	0.060	0.090
Barcol hardness	40–50	40–50	40–50
Specific gravity	1.40–1.45	1.40–1.45	1.40–1.45
Tensile strength, psi	10,000	15,000	15,000
Tensile modulus of elasticity, psi	1.3×10^6	1.3×10^6	1.3×10^6
Flexure strength, psi	15,000	24,000	24,000
Shear strength, psi	9,000	11,000	14,000

Plastic Panels Are Good Thermal Insulators

	Btu./(hr., sq. ft., deg. F./in.)
Fiberglass reinforced plastic sheet	3
Glass	5
Concrete	5
Steel	300
Aluminum	1,400

Cost/Sq.Ft. of Plastic Panels

	Thickness: 0.060-In.	Thickness: 0.090-In.
Flat	$0.62	$0.85
Corrugation		
1¼ in.	0.62	0.85
2½ in.	0.62	0.85
2.67 in.	0.70	0.92
4.2 in.	0.65	0.89
5.3 in. V beam	0 70	0.92

this test, it may be considered resistant to attack for prolonged periods of time.

▶ **Transmits Light**—Light transmission for these panels vary with their color from 10-45% for sheet designed where medium or low light transmission is desired, and up to 85% of visible light rays where maximum light transmission is desired.

Because of their nonhomogeneous composition, light transmission of any one sheet may vary by plus or minus 5%. Light transmission for this type material also decreases with increasing thickness. Thus a set of translucent structural panels of similar color, glass-resin composition and shape will transmit less light as the thickness progresses from 0.045 to 0.060 to 0.090 in.

▶ **Holds Heat**—These plastic sheets have an average coefficient of thermal conductivity of 3 Btu./hr./sq. ft./in. of thickness/F. This is the amount of heat transferred through the sheet when a heat source is placed in contact with one surface of a sheet and a heat receiver is placed on the other surface.

Thermal conductivity as compared to other standard construction materials is given in the table.

The heat transfer in which we are generally most interested is when heat is lost from warm air on one side of the fiberglass reinforced plastic sheet and gained by cool air on the other side. In such instances, the physical condition of the thin air layers next to the sheet surfaces largely control the heat transfer.

Over-all heat transfer varies according to the temperature of the air layers, the velocity of the air layers, and the mean temperature of the sheet. For any one set of conditions the effect of these variables can be calculated and included in the over-all heat transfer coefficient, U.

Values of U for 0.060 flat sheet are: 1.09 for an inside temperature of 80 F. and an outside 95 F. temperature; 1.19 for 70 F. inside, 10 F. outside. Units are Btu./hr./sq. ft./F.

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The 4" Durco Type F valve with renewable Teflon sleeve is now available from stock in Durimet 20 and Durco 18-8-S-Mo. This non-sticking, non-lubricated heavy duty chemical service valve is also available on special order in a wide variety of alloys including Chlorimet 2, Chlorimet 3, Monel, Nickel, and Inconel. Call or write

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DURCO
CORROSION RESISTING ALLOYS & EQUIPMENT

These values cover only two possible climatic conditions, but with a little judicious interpolation, it is possible to estimate *U* for other conditions.

Over-all heat transfer coefficient is affected very little by color, pigments, or type of surface finish for normal wind velocities, although it will be affected slightly by the different corrugations. To obtain the coefficient for the desired corrugation, it is necessary only to multiply the coefficients given by the appropriate area factor:

Corrugation	Factor
Flat	1.00
1¼ in.	1.11
2½ in.	1.11
2.67 in.	1.22
4.2 in.	1.17

▶ **Costs Are Important**—Translucent structural panels are available to match most industrial aluminum and steel sheeting.

The table on p. 154 lists the most commonly used shapes and corrugations with their approximate cost per square foot.

Special shapes are available from various manufacturers, which may be explored to meet special needs or applications.

Prices shown should be used merely as a guide. They offer an approximate structure prevalent for this material at the warehouse-distributor level. Material of this nature is all subject to quotation based upon such factors as quantity, variations in quality, thickness and weight of material to be purchased.

▶ **Fire Hazards**—The installation of corrugated reinforced plastic sheet in industrial buildings will not introduce a serious fire hazard when installed in accordance with recommendations. These recommendations apply to daylighting panels in both roof and sidewalls:

- Unlimited areas of fiberglass reinforced plastic sheet may be used in the roof and/or sidewalls if the building is provided with an approved sprinkler system.
- For occupancies and building construction in which sprinklers could normally be omitted, the row or band of fiberglass reinforced plastic sheets should not extend more than 250 ft. without being separated by 50 ft. of nonplastic roofing or siding material.

When fiberglass reinforced plastic sheets are used as small panels (area up to 100 sq. ft.), a 50 ft. separation of roofing or siding material should be provided every 400 ft.

Adjacent or parallel continuous rows or panels of plastic sheet should be separated by at least 10 ft. or nonplastic roofing and siding material.

Sidewall panels should be located near the eave line and not be more than 8 ft. high.

▶ **What Color?**—There are a number of colors recommended for industrial applications.

White is ideal where minimum solar heat absorption and transmission are needed. Recommended for hot climates in the south and west exposure. Ideally suited for converting strong sunlight to soft diffused illumination. Light transmission is 45%.

Clear has the highest light transmission and it's recommended where maximum possible light is desired, particularly for north and eastern exposures. Light transmission is 75 to 85%.

Light green is one of the most popular colors with the most universal application. This color is psychologically cool and pleasing in appearance. 60% light transmission.

Light blue: Cool, fresh appearance and low heat transmission making it ideal for hot climates where a double advantage of reduced light and heat may be required. 50% light transmission.

▶ **For Sound Panels**—Structural soundness includes freedom from leakage. Proper application is of paramount importance. One of the things to look out for is closure strips and sealing.

Closure strips are accurately molded of rubber composition to conform to all currently used translucent structural panel corrugations. Plastic panels usually require moldings or trim when used in modern plant construction. Corrugated materials leave spaces which should be filled, and the closures are filler strips especially engineered for that job.

Used as interior or exterior moldings, closure strips will retain accurate fit and proper resiliency for the life of the building. Strips of this nature are moisture proof. They are unaffected by extreme temperatures of heat or cold.

▶ **Installing Strips**—Filler strips are installed at the same time the translucent panels are nailed, bolted or screwed into place. This technique eliminates caulking and even the fastener's shank is sealed. Each corrugation is supported against cracking, crazing or flattening. Leading manufacturers ship strips packed into lineal foot requirements, thereby assuring no waste. Closure strips are manufactured to conform with the lengths of standard corrugated panels and if required can be cut very easily with a sharp knife.

▶ **Sealing Panels**—Interior and exterior applications of fiberglass panels also require that side and end laps be sealed where panels lap each other or other corrugated sheeting.

Translucent mastics of synthetic resins are available for use with translucent plastic panels. This material adheres to plastic, wood, metal and other building materials; setting to a tough resilient film that is completely light stable and water proof.

Clear mastic may be applied with a caulking gun, putty knife or brush and is specifically prepared for seams where translucency is desired. Prior to application, all surfaces must be free of grease, dirt or water. If extremely dirty, they should be washed with a mild detergent or lacquer thinner. Surfaces require no other special preparation, since mastics adhere well to all clean surfaces.

For best results, application from a regular caulking gun in a continuous bead of approximately ¼ in. in diameter is recommended. Mastic should be applied to the crest of the corrugation rather than the valley when applied along the length of the corrugation. A heavier bead or double bead is suggested for applications where a large amount of relative panel movement is expected.

US RUBBER GIANT ACID HOSE

Keeping water soft during a tough plant-expansion job

The chemical treatment building of the Kansas City Water Works is getting a new addition. This big job will take two years, during which time the building contractor is using a simple and economical means for conveying water-softening chemicals to the water supply.

He uses chemically-resistant U.S. Giant® Acid Hose, furnished with stainless-steel fittings.

The men find it extremely flexible and easy to handle, resistant to abrasion, impact and weather.

It remains unharmed by its highly corrosive cargo—hot lime slurry, ferric sulphate, alum solution, soda ash.

U.S. Giant Acid Hose is made for either suction or discharge service, replacing metal pipe because it handles highly corrosive solutions so well.

• • •

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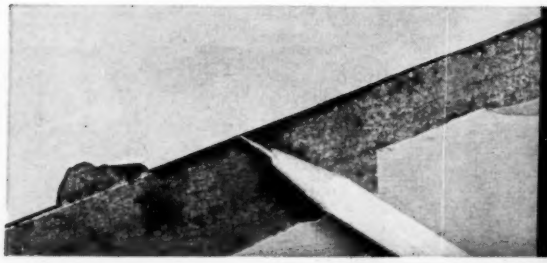
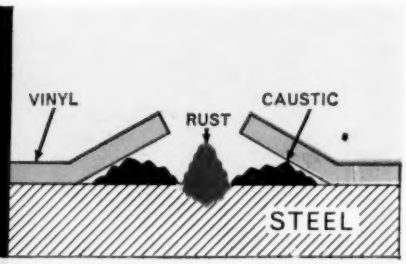
PUZZLED ABOUT PRIMERS?

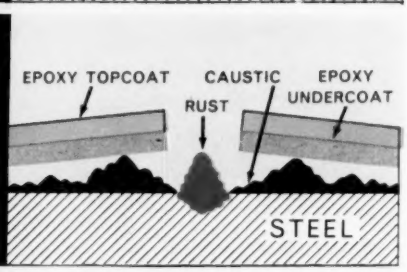
Here are tests you can duplicate

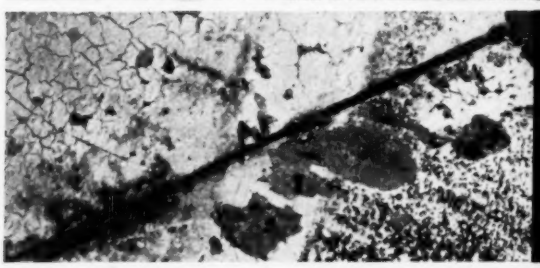


TEST 1—One coat of self-priming vinyl. Coating breaks away (L) due to severe undercutting (R), exposing metal to progressive corrosion.

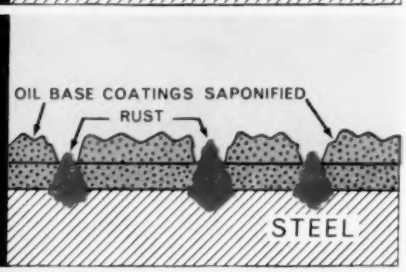


TEST 2—Epoxy primer, epoxy topcoat. Coating lifts off in single sheet (L) as adhesion fails (R), exposing entire surface to corrosion.

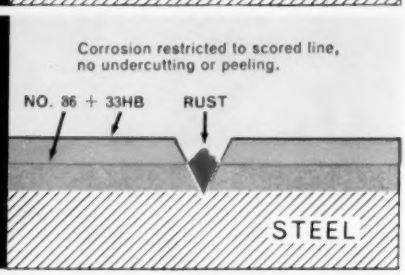




TEST 3—Oil primer, oil topcoat. Both coats fail completely (L) as underfilm caustic reacts on their oils to form soaps (R).



TEST 4—Amercoat's No. 86 inhibitive primer and No. 33HB vinyl topcoat. Corrosion restricted to scored line (L), no undercutting or peeling (R).



The purpose of these accelerated tests is to show what happens when various types of coatings are exposed to a typical corrosive environment. Four clean steel panels, free from mill scale and rust, were coated with different combinations of primers and topcoats. Each was scribed to bare metal and immersed in salt water in the presence of free oxygen, for two weeks.

As caustic deposits formed over cathodic areas of the steel in tests 1, 2 and 3, failure occurred in three ways. The vinyl, though not directly attacked, was undercut as caustic spread beneath the film and destroyed adhesion. The epoxy coating, known for critical adhesion to smooth metal, proved impervious to caustic attack. It was, however, lifted in its entirety as moisture spread beneath the surface. The entire oil paint film was quickly penetrated by the salt solution, creating widespread corrosion and caustic formation. The caustic then reacted with the oil to saponify the film.

In the fourth test the corrosion was limited to the score mark. Reason: Amercoat No. 86 Primer resists undercutting and adheres tenaciously, inhibiting electrolytic corrosive action.

The conclusions are clear. To provide long term protection in corrosive service, start with Amercoat No. 86 Primer, which provides a sound and lasting base for quality topcoats such as Amercoat No. 33HB.

Write today for complete data on Amercoat No. 86, and have the details on hand when planning your next important coating job.

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Chemical Engineering

People

What it's like to be a ChemE for Uncle Sam 161

Here—in the words of a man who knows—are the rewards, some of the difficulties and evidence that chemical engineers can find career satisfaction in gov't service.

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An optimistic study: "The Future Supply of Oil and Gas," by Bruce Netschert, poses a challenge to oil and gas technology and to chemical engineers in particular.

Meet Your Authors 168

Robert Freeman—a chemical engineer in government service . . . Flodin and O'Mara—dust and fume control experts. . . . Cheremisinoff—who has the know-how on plastic panels.

Letters: Pro & Con 174

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Jesse Coates, professor of chemical engineering at LSU wins two awards for technological prowess: one from the Louisiana Engineering Society, the other from the AIChE-ACS.

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American Smelting opens new Perth Amboy, N. J., casting facility . . . Kaiser Aluminum & Chemical Corp.'s new chlorine-caustic plant is now tuned up to full capacity. . . .

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Assembly is simple

with bucket elevators LINK-BELT-built from head to boot

CHAINS, SPROCKETS, PULLEYS — a type and size to handle all kinds of material, satisfy any application requirement.

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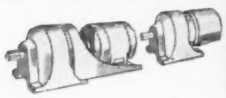

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BY R. F. FREMED PEOPLE ... YOU & YOUR JOB

Here's proof that chemical engineers can find rewarding professional and career satisfaction while working for the largest single employer of engineers.

How Chemical Engineers Serve Uncle Sam

Robert R. Freeman, Project Engineer, Biological Warfare Laboratories, Frederick, Md.*

Careers for chemical engineers in government service are often lightly regarded by the general public. As an example, our missile program has been responsible for the recent resurrection and propagation of that old chestnut that is particularly irritating: "They're renaming the missile 'Civil Service' because it won't work and you can't fire it."

Unfortunately, this attitude sometimes extends to the personnel departments and the management of the chemical process industries. A few personnel managers are honest enough to admit that a job applicant's government experience is heavily discounted in comparison with his industrial experience.

I realize that one article cannot correct a host of mistaken impressions, so I'll concentrate instead on introducing you to a small segment of a very large organization: the chemical engineer in the Federal Government.

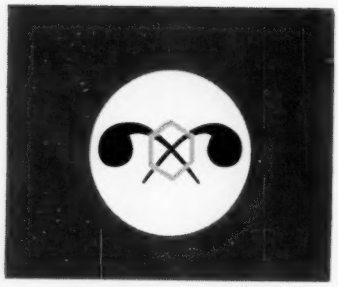
In this article, I'll try to describe some of the duties and responsibilities of the chemical engineer in government service. I'll try to describe how he operates, his rewards, some difficulties he experiences and, in general, evidence that interested chemical engineers can find satisfying and rewarding work in government service.

* Meet your author on p. 168.

How Many Are There?

In 1956 there were about 43,000 professional engineers employed by more than 30 federal agencies in installations throughout the U. S. Of these more than 1,000 were chemical engineers.

We estimate that about 75% of the chemical engineers in federal service are working in re-



search and development. About half of the chemical engineers are employed within the Dept. of Defense.

What Do They Earn?

The chemical engineer entering federal service with a B. S. degree from an accredited university will qualify for appointment at Grade GS-5, $4,480/yr. If he has 6 month's experience, an M. S. degree or has completed a 6 month's training program—which many agencies operate—he is eligible for appointment or promotion to GS-7, $5,335/yr.

Advancement to GS-9, $6,250, is possible after 1 yr. of satisfactory service. Engineers who prove their worth can advance rapidly. After 1 yr. in GS-9, they are eligible for promotion to GS-11, $7,465. The following year can bring eligibility for promotion to GS-12, $8,645. Advancement to higher grades is possible in the same manner.

However, promotion is not automatic. It depends upon experience, assignment of greater responsibilities and the occurence of vacancies.

Responsibilities in jobs in federal service are much the same as those in industry for each grade. Generally, the less experienced engineer is given a small portion of a project to carry out. He may supervise a few people in a production job. In a laboratory or in engineering office, he may work alone under the guidance of his supervisor. As he advances, he may be placed in charge of a laboratory, a pilot plant or a group of engineers and engineering aides. If he has a broad range of experience or if he is a specialist in a particular field, he may be assigned some staff responsibilities.

With promotion comes added responsibilities and a possible shift in work from technical to administrative. The chemical engineer then becomes responsible for the proper expenditure of considerable sums of money. His task responsibility which was funded for several thousands of dollars to cover his salary, equipment and some raw materials, looks quite insignificant in the face of responsibility for a project which may run up to $1,000,000 or more each year.

Plan, Coordinate, Evaluate

At almost every level, the chemical engineer must plan, coordinate his activities with other interested agencies and evaluate the results of his efforts.

Guidance is furnished by the echelons above him. However, guidance starts at the top in the form of broad policy—as it does in industry. Each succeeding level requires the engineer in charge to expand and detail the objectives of the level above and to define the problems to the level below him.

The chemical engineer may encounter a problem, the solution of which may more likely be found by contracting out the problem. Such research and development problems are usually contracted when manpower is not available, special technical knowledge is required or when special equipment or facilities are required.

The procedure by which research and development contracts are let is generally not known. Let me briefly sketch the chemical engineer's role in the process.

After deciding that it's best to contract a problem, the chemical engineer writes out the scope of the contract. This is a precise statement of the work to be performed by the contractor, whether it is to design and fabricate an item of equipment, to perform a test, to develop a new material or to provide special service. To the scope is attached a justification for having the work performed under contract.

Then, the engineer includes a cost estimate. If the contract is written by a defense agency, a security checklist is included. The security checklist shows the highest classification of work that is expected to be generated in the drawings or reports of the contractor and determines the need of a contractor to have a security clearance.

Finally, the engineer should include the names of at least three organizations whom he believes are equally qualified to perform the work stated in the scope of the contract.

Keeping Up to Date

It's the responsibility of the chemical engineer in federal service to keep abreast of all the latest developments in his area of work. He does this through correspondence with companies that announce their developments in various publications, by visits and through personal interviews with sales and technical representatives.

In this way the engineer gets to know and can evaluate the capabilities of organizations for performing work which he may need to contract.

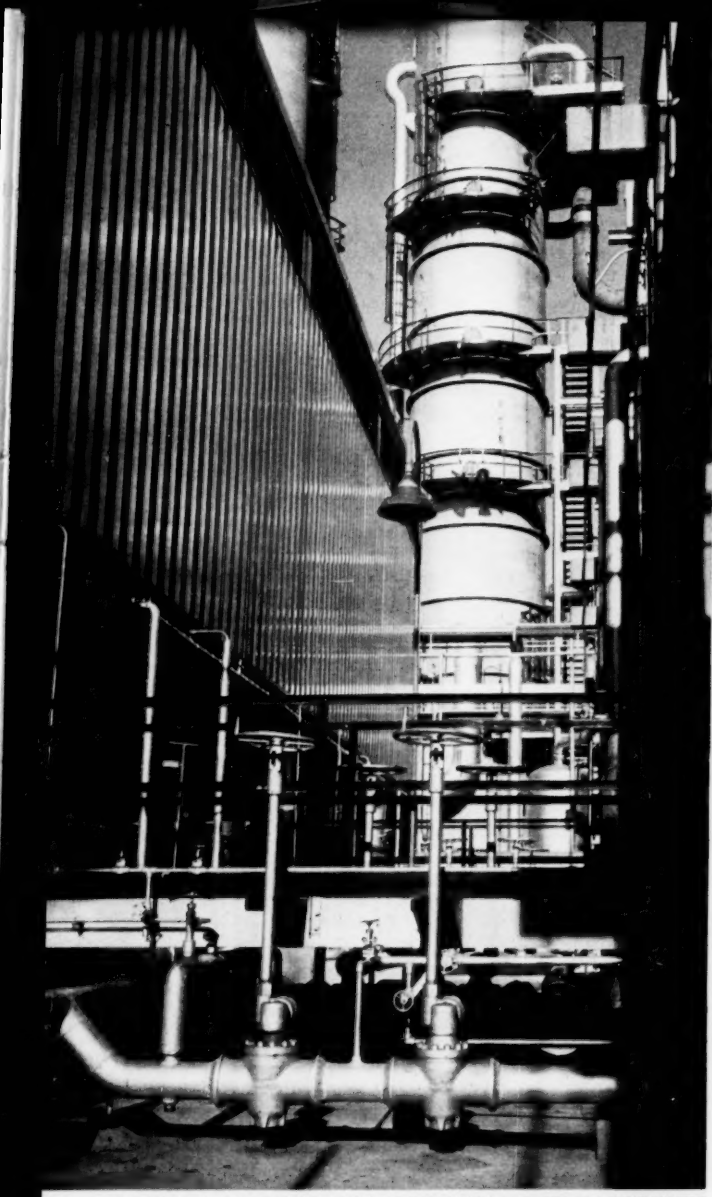
It's also helpful to the government engineer for organizations desirous of doing business with the government to send in some introductory information to the procurement offices of the installations they wish to serve. This may be in the form of advertising brochures, annual reports, personnel backgrounds, etc.

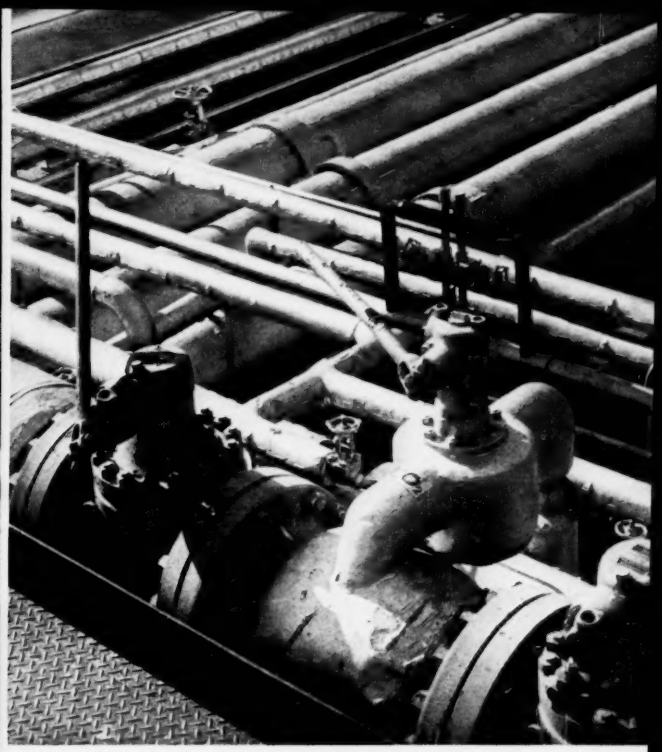
Before a contract is let, how-

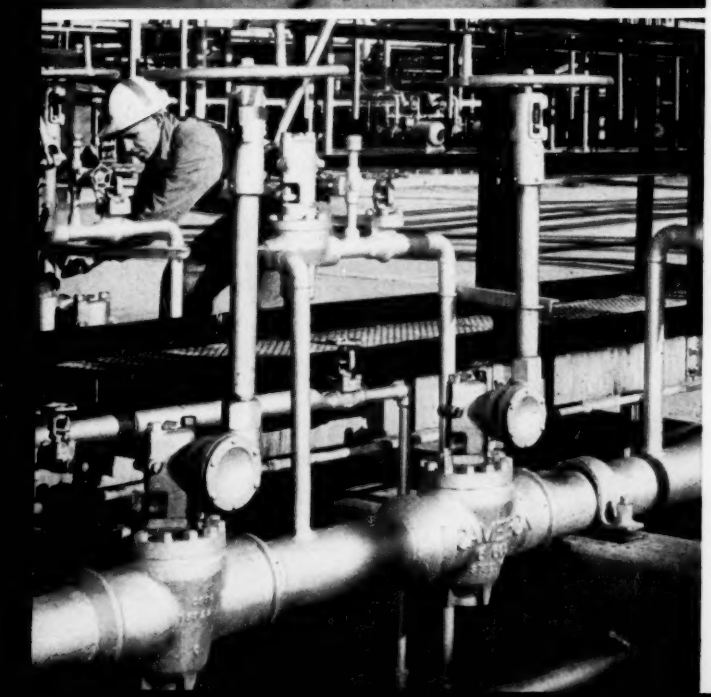
They Earn This Much, With a Prospect of More Soon

Grade	Maximum Annual Salary	House Proposal (H. R. 9,999)	Senate Approved (S. 734)	Comparable Industry Average*
GS-5	$4,480	$4,965	$4,815	$5,752
GS-7	5,335	5,930	5,735	6,780
GS-9	6,250	6,965	6,720	7,293
GS-11	7,465	8,340	8,020	9,168
GS-12	8,645	9,670	9,290	10,156
GS-13	10,065	11,275	11,000	12,005
GS-14	11,395	12,780	12,500	14,342
GS-15	12,690	14,235	13,800	16,602

*Figures for industrial salaries are those suggested by NSPE.







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These are Lift-Plug installations at the Delaware Refinery of Tidewater Oil Company.

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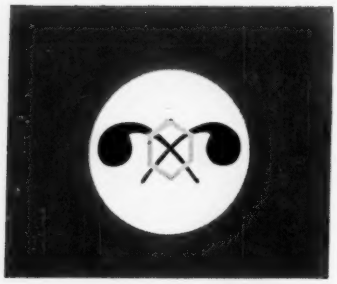

ever, the request must be approved, funds must be set aside to cover the cost of the contracts and a review board must ascertain that the contract is necessary. That it does not duplicate any current or previous work in that field.

Engineers O.K. Bids

Finally, the approved request is rewritten in the form of a legal document and requests to submit bids are sent to potential contractors. The chemical engineer then becomes a project officer or technical representative of the contracting officer. He must help the contracting officer, who is usually a nontechnical person, evaluate the bids.

After the contract has been let, the engineer is responsible for supplying the contractor all of the technical information and advice that is called for under the contract. He must see that the contractor confines his activities to the work called for under the contract and he must certify to the contracting officer in a monthly report that the contractor's work for the period is satisfactory.

It is primarily upon the chemical engineer's evaluation that the contractor's monthly vouchers are paid.

Gathering the Information

The first contact that the chemical engineer has with a new project usually involves the gathering of enough information to make a study of the feasibility of the project.

In gathering information from industry, the government engineer is particularly fortunate. Most companies are particularly cooperative in providing information to certain government engineers. This is unusual in view of the intense competition in the chemical process industries. But certain government organizations like my own have built an excellent reputation in industry for maintaining confidences.

Expert Help Available

In designing experimental work, the government engineer may be more fortunate than his counterpart in industry. The chances are better that the government man will have the help of some top-grade mathematicians, statisticians, and perhaps access to some fine computing equipment.

The chemical engineer need not stand alone in trying to solve the many difficult creative thinking problems that he is routinely faced with. Each year it is the individual engineer's responsibility to recommend the men in industry and in the universities who are specialists in the field he is working in. These men are then sought as government consultants. This has resulted in making available to the chemical engineer in government the services of the outstanding technical men in the country.

He's Hard-Working and Capable

Generally, the chemical engineer in government service is a hard-working, capable individual. He doesn't deserve to be thought of as not being able to get or hold a job in industry; or that he wouldn't be able to keep up with the brisk, unrelenting pace of industry.

It seems to be human nature—or at least the American nature—to evaluate quality by cost and a person's value to society by his apparent salary. The lack of professional recognition of the chemical engineer in government service is slightly more irritating to him then the difference in pay from industrial levels.

Is the government engineer, then, a dedicated individual?

To a certain extent the answer is yes. He works on a salary scale that is lower than industry's (see table, p. 162) and he may even work with the most lethal materials known to man at no extra pay.

On the other hand, the working conditions the government offers may be just what the individual is seeking. Federal agencies present excellent career engineering opportunities. Some agencies operate extension courses in which graduate credit may be earned. Others cooperate with nearby schools that offer advanced engineering courses. Annual leave for vacations and incidental use is liberal, ranging from 13 to 26 days/yr. All employees earn 13 days sick leave each year, and this may be accumulated without limit.

Participation in technical socities is encouraged. Some agencies try to send each engineer to at least one professional meeting a year at government expense. (When the government engineer attends a meeting, he usually concentrates on the technical program. His per diem allowance doesn't allow much else.)

Finally, the government, as the largest single employer of engineers, scrupulously lives up to its own fair-employment laws and carefully practices the nondiscrimination policies it requires of each of its numerous contractors.

Far from being collections of graybeards, many organizations in government are young, dynamic and aggressive. The large majority of chemical engineers in my own division, for example, holding grades of GS-12 to GS-15 and including our division chief, are under 40 years of age.

In conclusion, it is my opinion that it's wise for a young chemical engineer to investigate carefully and consider a career in government service. It can be satisfying and rewarding.

Next Issue: You Have a Key Spot in the Rocket Age

Why are companies in the fast-growing—but still infant—rocket and missile industry vying for the services of chemical engineers? Many of these companies are basically in the aviation industry. They would normally hire aeronautical, mechanical and electrical engineers. Yet, a head count in some rocket plants shows up more chemical engineers than any other kind. Why so many? See our next issue.

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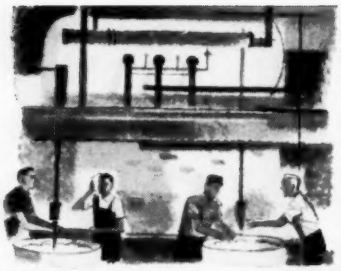
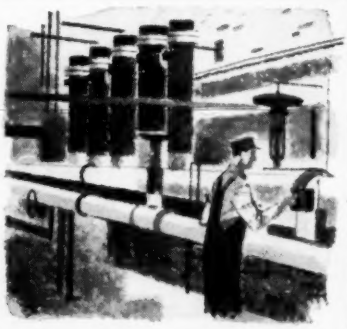


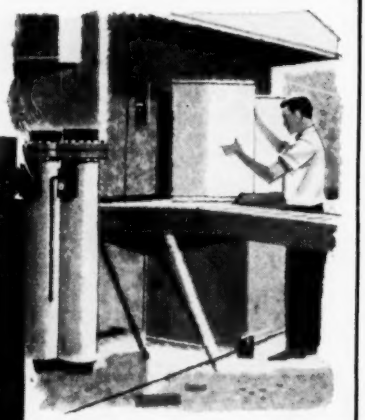
WATER—Factory heats water for washroom

During summer boiler shut-down, this company uses Chromalox Circulation Heaters and a ceiling-mounted storage tank to provide hot water for after-work clean up. Tapped steel mounting lugs factory-welded to the heaters made installation quick and easy. Water is heated mainly at night with offpeak power at lowest rates.



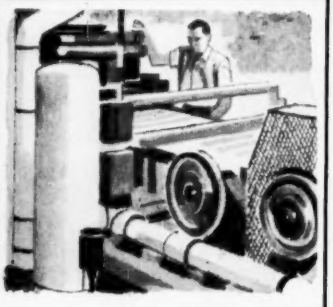
AIR—Aircraft factory heats air for thermodynamic testing

This nationally prominent aviation company installed seven Chromalox Electric Circulation Heaters to pre-heat air used for product testing. Four 80 kw heaters are rated for a maximum air flow of 450 lbs. per minute at 285 psi. Air enters the circulation heaters at from 90-210°F and is raised to a maximum of 900°F. Three 50 kw heaters have a maximum air flow of 250 lbs. per minute at 100 psi.



TRANSFER FLUIDS—Container manufacturer circulates hot oil to melt wax

As fibre drums leave this manufacturer's production line, a wax coating is applied for a smooth, grease-proof, moisture-proof interior. For a uniform coating of the desired thickness, wax must be sprayed at a constant 240°F temperature. A nozzle sprays wax up into the inverted drums as they are placed on a drain rack. As excess wax drains to a basin beneath, it is reheated and used again. The catch basin is heated by a transfer of heat from coils containing hot oil. Two 15 kw Chromalox Circulation Heaters are thermostatically controlled to keep the oil at a uniform 400°F. A separate thermostat maintains the 240°F wax temperature in the reservoir.



STEAM—Printing plant boosts steam temperatures to speed ink drying

A Chromalox Electric Circulation Heater is mounted alongside this press to boost steam temperature to 750° and eliminate the need for excessive boiler pressure. Although steam temperature takes a quick drop after leaving the heater, it still reaches the paper web at much higher temperatures than when the boiler alone was used and the steam had to travel a long distance.

Get the full story about Chromalox Circulation Heaters from your Chromalox Representative or write us direct for Bulletin 701 and new Case Studies.

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GReenwood 3-4477

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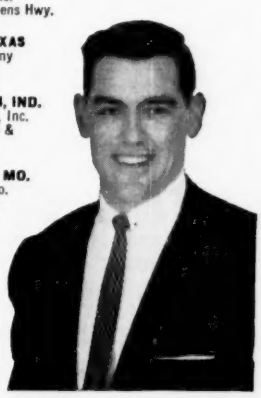

PEOPLE . . .

TECHNICAL BOOKSHELF

J. B. BACON

A Challenge to Oil and Gas Technology

Primary Recovery: ". . . continued growth in primary capacity can be sustained."

Secondary Recovery: ". . . we are about to enter a period of explosive growth . . ."

Natural Gas: ". . . considerable expansion in natural gas imports could take place . . ."

Optimistic Outlook

THE FUTURE SUPPLY OF OIL AND GAS. By Bruce C. Netschert. Johns Hopkins Press, Baltimore, Md. 134 pages. $3.

Author Netschert has here taken a new tack in examining oil and gas resources in the United States and the adjacent continental shelf.

He strikes a decidedly optimistic note in his predictions and in doing so lays down a sweeping challenge to oil and gas technology.

Basing his analyses on estimates of many experts, he converts "ultimate reserve" estimates to inferred "resource base" equivalents. This represents, the author explains, present proved reserves, currently unrecoverable content of known reservoirs, and the total content of undiscovered reservoirs, without regard to present or future technologic feasibility of discovery and recovery.

► **Recovery Factor** — Since, to the best of current knowledge, recovery averages about one-third of the total oil present in a reservoir, Netschert multiplies ultimate-reserve estimates by a factor of three to obtain inferred resource-base equivalent.

By taking into consideration technological improvements that can be expected, Netschert concludes that domestic availability of crude oil in 1975 will be on the order of 6-billion bbl.—4 billion bbl. by primary recovery and 2 billion bbl. by secondary recovery.

Also, in comparing capacity production estimates, the author takes a critical look at the decline-curve approach at forecasting. A major shortcoming of this approach, he says, is exclusion of technological improvements. This is embodied in assuming a given amount of ultimate reserves, hence current technology.

► **Natural Gas**—The same considerations come into play in forecasting natural-gas availability, since much natural gas is found along with oil.

Thus, as regards technology, the author believes that imports of liquefied methane could become an important factor by 1975. However, since natural gas recovery levels are already high, he assumes no appreciable improvement here and sets 1975 availability at 22.5 trillion cu. ft., rather than higher.

Netschert considers other domestic sources of hydrocarbon energy and also foreign oil and gas.—JBB

BRIEFLY NOTED

PROTECTION AGAINST NEUTRON RADIATION UP TO 30 MILLION ELECTRON VOLTS. 88 *pp. National Bureau of Standards Handbook* 63. *Superintendent of Documents, U. S. Government Printing Office, Washington* 25, *D. C.* 40¢. Gives rules, recommendations and references regarding neutron radiation hazard.

RUSSIAN-ENGLISH SOLID STATE GLOSSARY. 90 *pp. Consultants Bureau, Inc.*, 227 *W.* 17 *St., New York* 11, *N. Y.* $10. Includes over 4,000 terms in solid-state theory, crystallography, physics of metals, metallurgy, ferromagnetism, semiconductors and general quantum theory.

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Superior quality forged body —precision machined
Uniform wall thickness —no weak spots
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PEOPLE...

MEET YOUR AUTHORS

M. A. GIBBONS

Robert R. Freeman

YYJ Feature: HOW CHEMICAL ENGINEERS SERVE UNCLE SAM. PAGE 161.

A chemical engineer tells you what it's like to work as a technical expert in government service.

At a recent AIChE meeting in Chicago, Robert Freeman presented a paper on the drying of viable biological materials by solvent extraction and azeotropic distillation.

After the session, Associate Editor Ray Fremed nabbed Freeman and began asking some very specific questions about Freeman's work, the responsibilities of chemical engineers in government and how they operate within the framework of Civil Service.

By the time Freeman was ready to call it a day, he found he was scheduled for a forthcoming issue of *Chemical Engineering*.

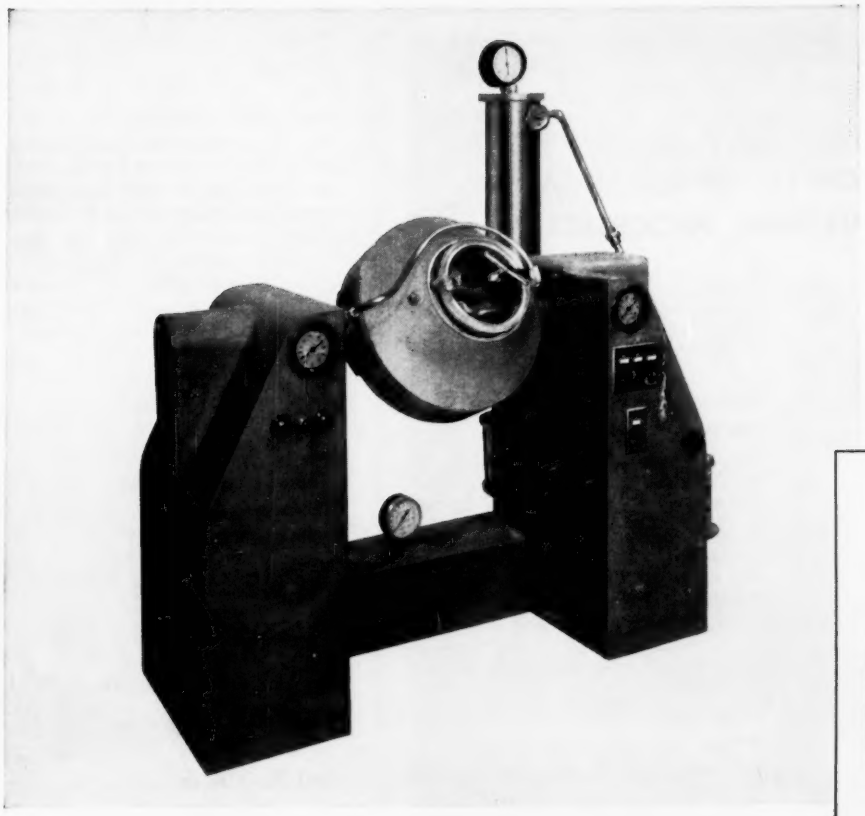
Robert Freeman went to Johns Hopkins University from 1940 until 1943, when in June of the latter year, he left school to enter OCS Chemical Warfare Service—at the age of 19. After receiving his commission, he was assigned to work with a group testing war gases under jungle conditions in Florida.

In May 1944, he was transferred to Huntsville Arsenal, Ala., where he worked as shift supervisor in the white phosphorous munitions filling plant. In July, he moved on to Camp Detrick in the biological warfare effort. After brief orientation, he was assigned as Army representative for the construction of fermentation and laboratory buildings in Terre Haute, Ind.; when completed, he stayed on as plant engineer.

After his discharge from the service, he reentered Johns Hopkins and earned a bachelor of engineering degree in 1947.

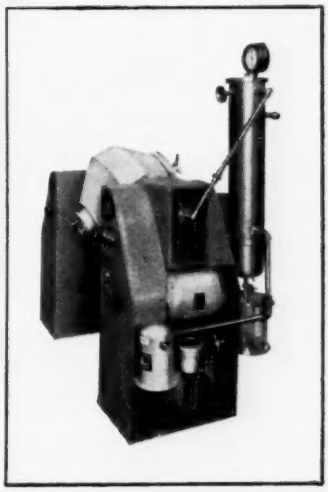
Baltimore Gas & Electric Co. hired him as a chemical engineer in its gas manufacturing plant. Then, in January 1951, he entered Civil Service at the Army Chemical Center, Md.

First assignment was in design and development work on mobile anti-gas impregnating plants at the chemical and radiological laboratories. Next, he served as shift supervisor in the nerve gas pilot plant. In 1953, he became process engineer in the biological warfare branch of the pilot plants division at the engineering agency. Duties there consisted of plant design, production startup and liaison responsibilities to Fort Detrick.



Completely integrated vacuum drying system using P-K Vacuum Tumbler Dryer Blender.

Side view, showing vacuum pump, condenser and related components. Note compact arrangement and short lengths of piping.



The P-K Vacuum Tumbler Dryer

A faster, better way to vacuum-dry heat sensitive materials

The remarkably fast drying action of the P-K Vacuum Tumbler Dryer—a fraction of the time required by conventional methods—is partly accomplished by baffling in the jacket, which circulates the heating medium uniformly around the containing vessel. In addition, rapid generation of vapors produces a scrubbing action on the walls of the blender, improving the heat transfer rate to a marked degree.

These factors, important as they are, do not tell the whole story. The P-K Dryer operates at optimum efficiency when it is part of a completely integrated, factory engineered system, instead of an on-site assembly of component parts and piping—which increases the cost and impairs the attainable benefits. For heat senstive material drying, in a closed system, there must be a perfect balance of jacket circulation, vapor filter, vapor line, *compact* piping, vacuum line, vacuum pump and effective controls.

These essential relationships P-K provides, including factory designed supports to house the entire operation. The illustrations show a unit used in P-K's Customer Service Laboratory to pre-test the specific requirements of your formulae. You are urged to use this service without cost or obligation. Similar integrated units can be designed for your needs in capacities from 1 to 150 cubic feet.

Use the coupon to secure Data Sheet No. 1530. Better yet, contact our Customer Pre-test Department for a test if your heat sensitive formulations are difficult to produce rapidly, satisfactorily—and economically.

Patterson Kelley

Chemical and Process Division

Executive offices and plant: East Stroudsburg, Pa.

P-K "Twin Shell" Blenders • Heat Exchangers • Packaged Pilot Plants • P-K Lever-Lock Doors • P-K Cone and Ribbon Blenders

Patterson-Kelley Co., Inc.
1502 Hanson Street
East Stroudsburg, Pa.

Send me the information on vacuum drying checked below:

☐ Data Sheet No. 1530
☐ P-K pre-test of our product

*Name*_____ *Title*_____

*Company*_____

*Street Address*_____

*City*_____ *Zone*____ *State*_____

an adams report *NO. 2 OF A SERIES*

RECIRCULATION MAY BE KEY TO FUTURE GROWTH OF CHEMICAL AND INDUSTRIAL PROCESSES

How much water do you need to make: a ton of steel? a ton of synthetic rubber? a ton of bromine? a barrel of beer?

These are not empty questions. They point to a critical problem which confronts management today in its plans for tomorrow. It is more critical than most of us realize . . . for industry today uses as much water as all other users.

Industry's Needs in 1975

Water is vital for chemical and industrial growth. By 1975, industry will require 215 billions of gallons daily. That is a 100% increase over our current industrial consumption . . . more than we currently consume for all uses combined.

Competing for this water will be irrigation farmers and the general public. Their combined needs by 1975 will be up 40 billion gallons a day . . . possibly even more.

What is the Supply Picture

More than 40% of the communities in the United States already have a critical water supply problem. Yet, to meet the 1975 needs, our supply must be expanded by 50%, at an estimated cost of $50 billion.

Indications are that industry is going to have to bear its part of this cost. Certain communities are already moving to place flat water rates on all users . . . regardless of the volume used. Other groups are demanding a national water policy with full Federal Government regulation of natural sources.

Chemical Industry's Stake

Shortage of water can be a most serious threat to the expansion hopes of the chemical industry. A glance at the following table shows why. You need approximately:

20,800 tons of water per ton of	Bromine
2,500 " " " " " "	Synthetic rubber
830 " " " " " "	Viscose rayon
300 " " " " " "	Newsprint
208 " " " " " "	Smokeless powder
15 " " " " " "	Coke from coal

While process refinements may be able to reduce slightly the amount of water needed for each product, the gains will be minor.

Difference Between Use and Consumption

This is best illustrated by the water needed to make a ton of steel. The industrial average is 65,000 gallons (271 tons). In the past, 65,000 gallons of water flowed out of a river through the steel mill and back into the river again for each ton of steel made. In this case, use and consumption are one and the same thing.

On the west coast, a large steel mill now requires only 1,100 gallons of makeup for each ton of steel produced. This steel mill has its own recirculation system which holds several million gallons of water.

This water is recirculated at a rate equal to 65,000 gallons per ton of steel produced. The only water consumed is that lost due to evaporation or through leakage. Thus, net consumption has been reduced to 1,100 gallons.

Two Bulletins Available

One of the most important pieces of equipment in a recirculation system is a filter. Where high quality process water is needed, diatomite filters will provide an effluent second only to distilled water. Bulletin 651, released by the R. P. Adams Company, Inc., 507 E. Park Drive, Buffalo 17, N. Y., covers this type of industrial water filter.

A second publication, Bulletin 909, covers an Automatic Water Filter which is frequently used in recirculation systems where the water is used for less critical applications. This bulletin is also available on request from the R. P. Adams Company at the above address.

By the way, it takes almost two tons of water to brew a barrel of beer.

CONSERVE WATER, OUR MOST VALUABLE NATURAL RESOURCE

R. P. ADAMS COMPANY, INC.
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BUFFALO 17, NEW YORK

Ma-58

We have a problem involving liquid filtration. Ask your local representative to call on us.

Name_____ Title_____
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City_____ State_____

AUTHORS . . .

In November 1953, Freeman was transferred to his present post at Fort Detrick; he is staff engineer responsible for planning, coordinating, and evaluating certain aspects of the research and development program. He handles cut process design and general investigations in the field of bio-engineering.

Carl R. Flodin

CONSIDERATIONS FOR CONTROLLING DUST AND FUMES. PAGE 139.

Along with Co-author O'Mara, Carl Flodin is busily engaged in consulting engineering work in the field of dust and fume control, under the name of O'Mara and Flodin, Inc., of Los Angeles, Calif.

Flodin is a licensed professional engineer and an electrical engineering graduate of the University of Washington.

From 1927 until 1942, he worked in various capacities for the Commonwealth Edison Co., Chicago, and Consolidated Edison Co. of N. Y., Inc.

In 1942, he took a war-leave of absence to take on the post of design and construction engineer in the DPC magnesium plant in Austin, Tex., operated by International Minerals & Chemical Corp.

When the plant shut down in 1944, he joined Western Precipitation Corp. where he became chief technical engineer in charge of application of electrostatic precipitators and other dust and fume collection equipment for industry.

In 1956, Flodin became a member of O'Mara and Flodin, Inc.

Over the years, Flodin has authored several papers in the field of dust and fume collection. He is a member of the American Institute of Electrical Engineers and the Air Pollution Control Association.

Paul N. Cheremisinoff

PLASTIC PANEL COVERINGS. PAGE 152.

Paul Cheremisinoff is general manager of the Paterson, N. J., plant of the Alsynite Co.

Much of his job consists in technical service and application in the expanding field of glass fiber plastic sheeting. He's also responsible for production and plant operation.

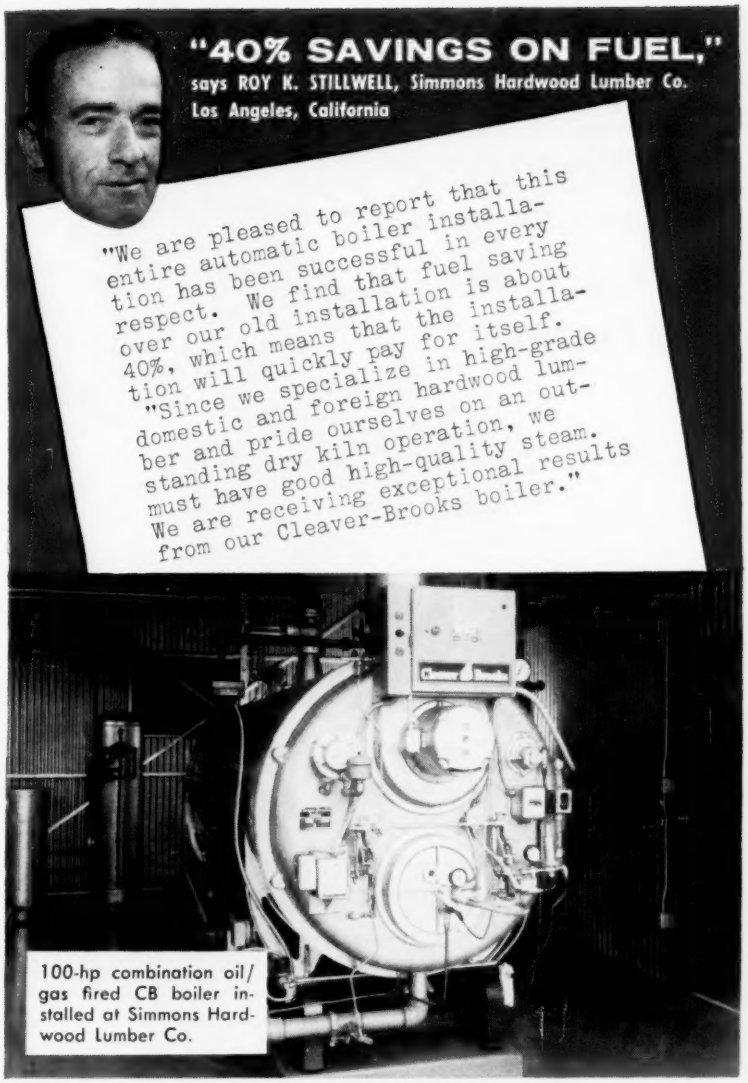
Cheremisinoff reports that the firm is considering many novel uses for this relatively new construction material.

Industrial experience includes work for M. W. Parsons-Plymouth Inc., as plant research chemist; for Swan-Finch Oil Corp., as research chemical engineer; and for Joseph Turner Co., as plant manager and technical director. In the latter post, which he held from 1953 through 1956, he worked with many unit operations and processes.

Publications, to date, consist of over twenty articles and sundry contributions to various trade and technical journals.

Educational background includes a B. S. in chemical engineering from Pratt Institute in 1949 and an M. S. in engineering from Stevens Institute of Technology in 1952.

Professional memberships include the American Chemical Society as well as the American Institute of Chemists.


"40% SAVINGS ON FUEL,"
says ROY K. STILLWELL, Simmons Hardwood Lumber Co.
Los Angeles, California
"We are pleased to report that this entire automatic boiler installation has been successful in every respect. We find that fuel saving over our old installation is about 40%, which means that the installation will quickly pay for itself.
"Since we specialize in high-grade domestic and foreign hardwood lumber and pride ourselves on an outstanding dry kiln operation, we must have good high-quality steam. We are receiving exceptional results from our Cleaver-Brooks boiler."
100-hp combination oil/gas fired CB boiler installed at Simmons Hardwood Lumber Co.

For process steam economy . . .

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Five square feet of heating surface per boiler hp is another reason why CB boilers give you longer service life with less maintenance. Every CB boiler is guaranteed to operate at a minimum efficiency of 80%.

Each Cleaver-Brooks self-contained boiler is a complete package. Fully factory tested, it's ready for installation, service connections and operation. No make-ready delays . . . no extra parts needed.

A trained technician starts your CB boiler, adjusts it for your specific needs, and trains your attendant in care and maintenance.

Available in 19 sizes, 130 models, 15 to 600 hp — steam or hot water, gas, oil, or combination oil/gas fired.

For more facts on the self-contained CB boiler, contact your dealer or write: Cleaver-Brooks Company, Dept. F, 345 E. Keefe Ave., Milwaukee 12, Wisconsin.

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NEW GIANT

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Formerly this job took four men with an open-end wrench and dolly bar 2½ hours ($1,750) to do. Now a new 10⅝-in. hexagon socket developed by *Snap-on* Tools Corporation does the job in 15 minutes ($175). This giant socket is driven by a power-operated slugger.

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AUTHORS . . .

Cheremisinoff, a native of New York City, now lives with his wife and two sons in Dumont, N. J.

Richard O'Mara

CONSIDERATIONS FOR CONTROLLING DUST AND FUMES. PAGE 139.

Quite an authority on air pollution control problems, Richard O'Mara has been associated with dust collection, drying and air separation work since 1927.

Today, he and Co-author Flodin head up a consulting engineering firm known as O'Mara and Flodin, Inc., Los Angeles, Calif. The firm specializes in dust and fume collection, drying and air handling problems.

O'Mara began his career with the Raymond Division of Combustion Engineering, Inc., where he was engaged in engineering for grinding, drying, dust collection, incineration and associated process systems. When he left the firm in 1937—after 10 years of service—he was manager of the dryer and incineration division.

From 1937 until 1955, he was in charge of engineering sales for Western Precipitation Corp. He handled the firm's Cotrell electrical precipitators, cyclonic collectors, reverse-jet filters, spray dryers and other industrial products. When he left the firm in 1955 he was a vice president.

O'Mara is author of many technical papers and has obtained a number of patents in his chosen work.

He is a licensed professional engineer in the State of California.

"takes it" as fast as you can "dish it out"!

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PUMP PROBLEMS
write
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BEFORE DECIDING ON TYPE OF PUMPS . . .
SEE TABER BULLETINS
May avoid costly pump misapplication.
Vertical pump illustrated, for handling chemicals, please request Bulletin V-837. Horizontal Pump, Bulletin C-355.
FIG. 19,488
TABER PUMP CO.
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291 ELM ST.
BUFFALO 3, N. Y.
FIG. 6061
TABER

PEOPLE . . .

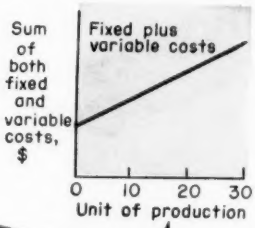
LETTERS: PRO & CON

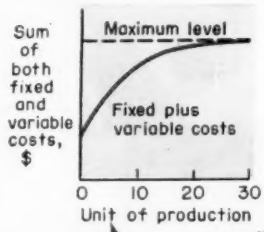
C. H. CHILTON

Actually Processing Costs Are Mixtures—Fixed and Variable

For Example . . .

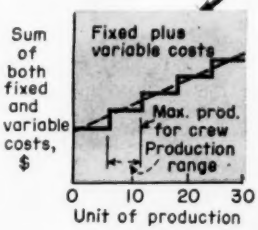
A production crew can operate within a range of production, but beyond that, additional operating people must be brought in to boost production.

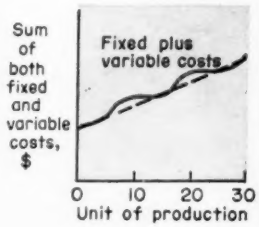




Supervisor represents a fixed total cost. Operating labor is a variable cost. Size of operating crew depends on production volume, but one supervisor can handle crew.

Supervisor is a fixed cost, and the operating crew is a variable cost. However, a maximum point is reached, where production increases without increased costs.





Production crew and equipment (or other variables) can operate over a range. For additional production a number of variables must be added to the process.

Fig. 2

Con: Mixed-Up Graphs

Sir:

Our library has recently obtained for me two reprints of your Report on Cost Control Systems (October 1957, pp. 233-248). I would like to point out that the descriptive matter in Fig. 2 (p. 240) appears to be associated with the wrong graphs; this can be somewhat confusing.

A. V. BAILEY
Hardman & Holden Ltd.
Manchester, England

▶ *We appreciate Mr. Bailey's calling this error to our attention. Readers may correct Fig. 2 as shown above.*—ED.

Con: Polyvinyl Acetal

Sir:

In your story on our new plastic, Delrin acetal resin (Feb. 10, 1958, p. 88), you have mistakenly applied the phrase "polyvinyl acetal."

Unlike Delrin, polyvinyl acetal sheeting is currently commercially available and is used as the tough interlayer in safety glass. Delrin is tough, too, but as a linear acetal is a rigid thermoplastic represented by the formula $(—OCH_2—)_n$.

The two are not to be confused. Delrin is unique when compared with typical commercial thermoplastics in that it is the first to maintain its mechanical strength so close to its melting point. In rigidity and strength this resin is like rigid polystyrene and unplasticized polyvinyl chloride. These materials are usually made tough at the expense of their original rigidity by introduction of plasticizers, blending them with flexible polymers or copolymerizing several monomers. The toughness of Delrin, however, is not attained by any of these methods but is a basic quality of the polymer.

CHARLES S. BOOZ
E. I. du Pont de Nemours & Co.
Wilmington, Del.

Limits of Integration

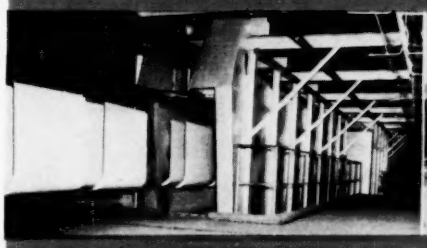
Sir:

I have followed with interest your recent Refresher articles on mathematical methods for approximation by W. E. Ball and R. C. Johnson.

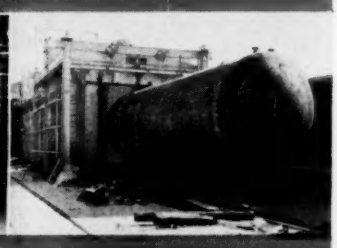
Your December issue (pp. 282-8) featured a very interesting and instructive article on numerical integration and differentiation. Please correct the limits of integration used in the development of the Newton-Cotes approximate quadratic formula.

AVONDALE
INDUSTRIAL CONTRACTS DIVISION

GREATEST
INDUSTRIAL CAPACITY IN THE SOUTH
serving
THE
CHEMICAL INDUSTRY

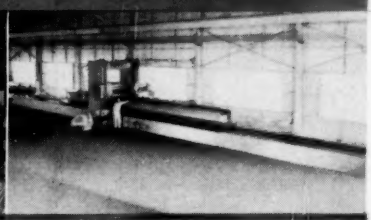


Avoscraft Porcelain Enamel—this product is industry's choice because of its durability, cleanliness, and ability to withstand corrosion, heat and gas fumes.

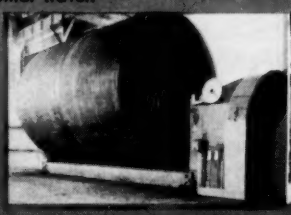


Tank for propane barge.

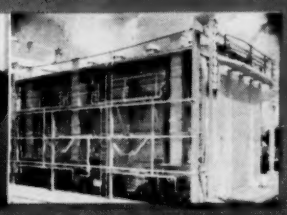
High precision horizontal boring mills—this one has 6" diameter bar, 7'8" vertical travel of spindle and 14'6" horizontal travel.



Planer with 84" x 84" x 40' stroke and maximum cutting speed of 210 ft./minute.



Bending roll pictured above rolls steel plate up to 4¼" thickness.



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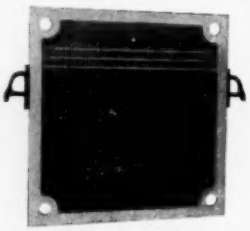
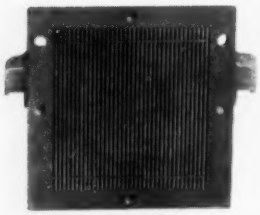
Large filter press with rubber-covered cast iron plates and frames.

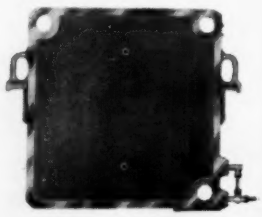
SHRIVER FILTER PRESSES



Polyester plate fiberglas-reinforced.



Solid rubber plate.



Stainless steel plate.

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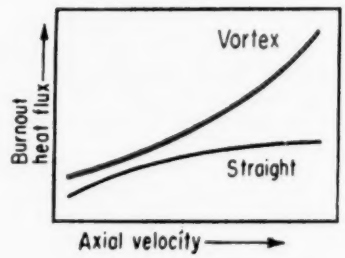
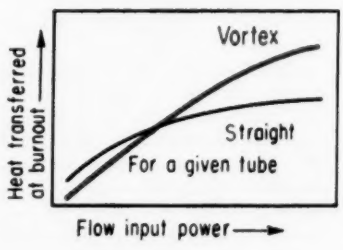
PRO & CON . . .

They should be x_0 to x_2, rather than x_0 to x_1.

P. P. GUDAITIS
E. I. du Pont de Nemours & Co.
Wilmington, Del.

► *Mr. Gudaitis is right. He refers to the equations in the first column of p. 284. The final correct equation appears in the box at the top of that page.*—ED.





Pro: Vortex Boiling

Sir:

The response to your *Chementator* item about our work on vortex boiling (Jan. 13, 1958, p. 78) has been very heavy.

I have recently devised a more precise interpretation of the probable mechanism of vortex boiling, as well as a preliminary analytical correlation of all our data to date. In addition, I have made many comparisons of boiling with straight-through vs. vortex flow and have derived curves like those above.

W. R. GAMBILL
Union Carbide Nuclear Co.
Oak Ridge, Tenn.

Luck Plays Its Part

Sir:

Thank you for the fine presentation you gave my article, "What Makes a Successful Chemical Engineer," in your March 10 issue (pp. 171-174).

Lest some reader be confused with the discrepancy between

the percentages in the display type and those given in the text, here is how the numbers should have appeared:

Ability: 50%.

Motivation and personality, combined: 35%.

Fortuitous and chance factors: 15%.

RICHARD S. SCHULTZ
Industrial Relations Methods, Inc.
New York, N. Y.

► *We are sorry to have marred an excellent feature with a silly slip on our typewriter keyboard.*—ED.

Someone Dropped the Ball

Sir:

After reading your open letter on the shortage of chemical engineers (Mar. 24, pp. 161-164), my conviction becomes more firm that scientific and engineering leadership dropped the ball long ago and are having a hard time finding it. Your rhetorical questions and reported remarks of members of the AIChE career guidance committee tend to betray a lack of awareness of the vital nature of the problem.

While we are "taking a long, hard look at the problem," our friendly (?) competitors in Russia are turning out well-qualified scientists and engineers in greater numbers than can conceivably be used in Russia. Shall we go the way of the tired and old?

CLARENCE ALLISON
Oakland, Calif.

Sir:

I agree wholeheartedly with the committee member who feels that we should participate in guidance programs, even though some people feel that time spent in such endeavors is wasted.

I do not consider myself a recruiter, and I feel it is wrong to recruit anyone for chemical engineering. It is my belief that we should guide only, pointing out all the aspects of our field.

The present economic situation is one of the main problems in student guidance work. Students read, as I do, about the continuing layoff of engineers in all fields, and so, in the minds of many high school students, it is unwise to seek a future in these fields if there won't be jobs

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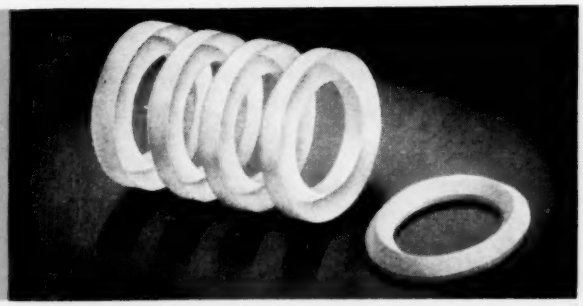
in corrosive service

cost less per month of life
cost less in shutdown time
cost less in maintenance labor

VALVES



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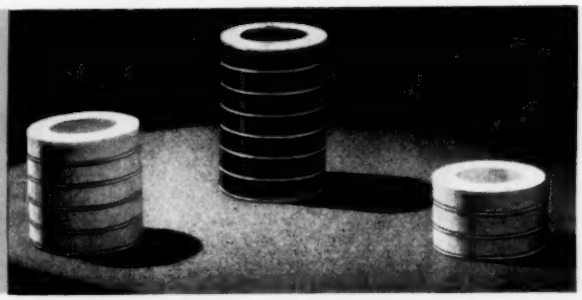
PUMPS



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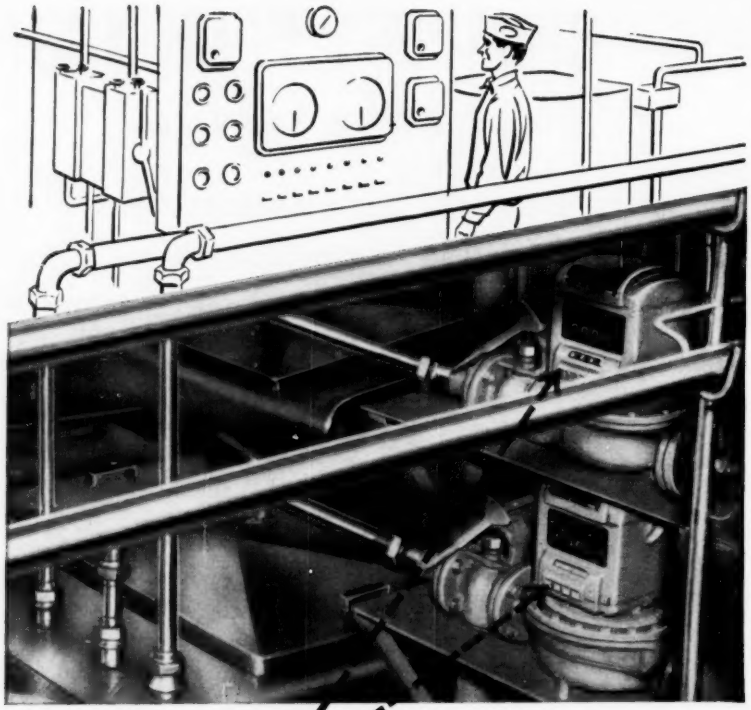

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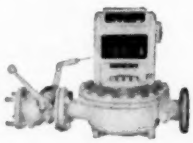

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awaiting them. My biggest challenge, I feel, is impressing young people (and I am one, too) with the fact that even if I find myself laid off, my engineering education and experience, limited though it may be, is still invaluable.

These comments I have made because I am deeply concerned with the education problem and the multitude of persons choosing fields other than chemical engineering.

CYRUS H. HOLLEY
Ormet Corp.
Gonzales, La.

Con: License Restrictions

Sir:

We are anxious to correct an apparent misunderstanding concerning the limitations imposed by our license agreement for the Turbulaire-Doyle scrubber (*Chem. Eng.*, Feb. 24, 1958, p. 84).

Your statement that the "Doyle scrubber is now available for general industry use, except for phosphates, through Western Precipitation Corp." is not correct.

Our only restriction is that we are not licensed to supply equipment for treating gases arising from phosphate fertilizer operations in plants designed by Dorr-Oliver Inc. The scrubber is being used successfully on a number of phosphate operations.

GILBERT G. SCHNEIDER
Western Precipitation Corp.
Los Angeles, Calif.

Our Policy on Unions

Sir:

A short note has been brought to my attention on p. 69 of your March 10 *Chementator*. You reported that the Union Carbide Corp. has established a temporary moratorium on salary raises for engineering and other personnel, but that the stockholders are getting the usual dividends and the unionized personnel are getting their scheduled increases.

Such an announcement tends to encourage engineers to participate in union activities. If this is the intention of your

editorial policy, this is appropriate. However, I suspect that the American Institute of Chemical Engineers would not like to encourage engineers to undertake union activities.

CARL C. CHAMBERS
Vice President for Engineering Affairs
University of Pennsylvania
Philadelphia, Pa.

▶ *We are neither for nor against engineers' unions; we are for engineers. Our editorial policy is to report and interpret—not to suppress—factual information which is important and significant to engineers in the chemical process industries. Our policies are entirely independent of AIChE.*

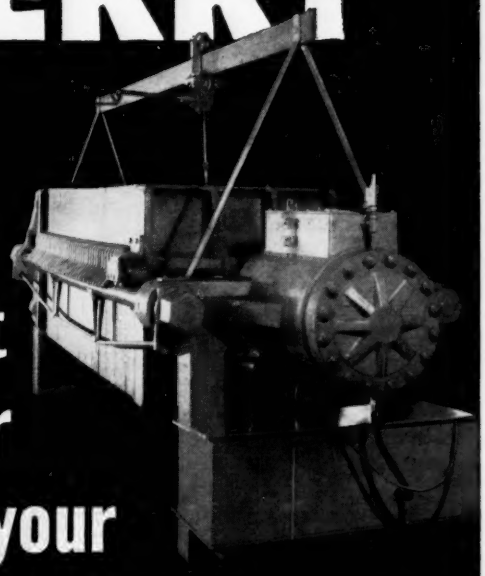
If Union Carbide's actions tend to encourage engineers to participate in union activities, as Dr. Chambers suggests, then the responsibility lies with Union Carbide, not with any newspaper or magazine which reports such actions.

On the other hand, we don't agree with Dr. Chambers that publication of unpleasant facts encourages union activities. We hold with the opposite view, that suppression or misrepresentation of facts is the worst possible public relations and employee relations policy. This view was well expressed recently through the pages of Chemical Week *by a research director commenting on the manpower situation: "The hue and cry about a technical manpower shortage is apparently misrepresentation. I believe this will result in unionization in many areas."*—ED.

Knightly Foolishness

The illustrator who prepared drawings for our Manufactured Gas Report let his imagination play tricks. He thought that a medieval knight would be appropriate with the Hall thermal reformer (CE, Mar. 24, p. 124).

SPERRY



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PEOPLE . . .

NAMES IN THE NEWS

M. A. GIBBONS

Man of the Month: Jesse Coates

Coates is also first recipient of AIChE-ACS award set up in his father's honor.

Professor of Chemical Engineering at LSU receives the Louisiana Engineering Society's Technological Accomplishment Medal

On the basis of his past and recent contributions in the fields of chemical engineering research, professional development of engineers and chemical engineering education, Jesse Coates was recently backed by the Baton Rouge section of the Louisiana Engineering Society to earn the Society's Technological Accomplishment Medal.

It wasn't long before section members were back-slapping their nominee.

Not an annual award, the LES Medal is awarded only as conditions warrant. So far, only some six other men have earned the award since it was set up.

▶ **More Honors**—But still further congratulations are in order. This year, the Baton Rouge section of the AIChE and the ACS established the Charles E. Coates Memorial Award—in honor of Jesse's father. And, at a recent banquet, Jesse became its first recipient.

This new award will go each year to a leading chemist or chemical engineer in the Baton Rouge area. Specifically,

though, Coates was selected for his significant research contributions in the fields of liquid-state physical properties, simplified chemical engineering calculations and thermodynamics of solutions.

He earned the LES award for the same reasons. According to the letter of nomination, Coates' "highly theoretical yet very practical studies have put the calculation and measurement of liquid-state thermal conductivity and the calculation of liquid-state specific heats on a firm foundation — a foundation which hitherto had not existed . . . Coates has attacked the notoriously time-consuming multi-component distillation calculations and multi-effect

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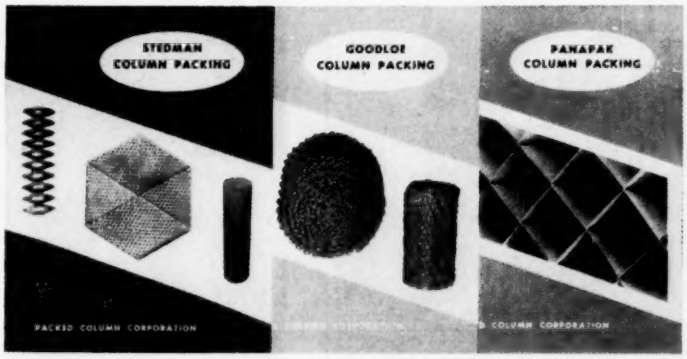

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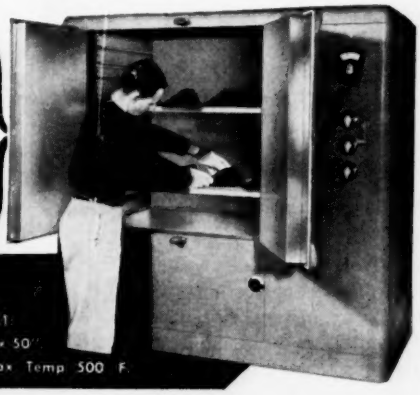

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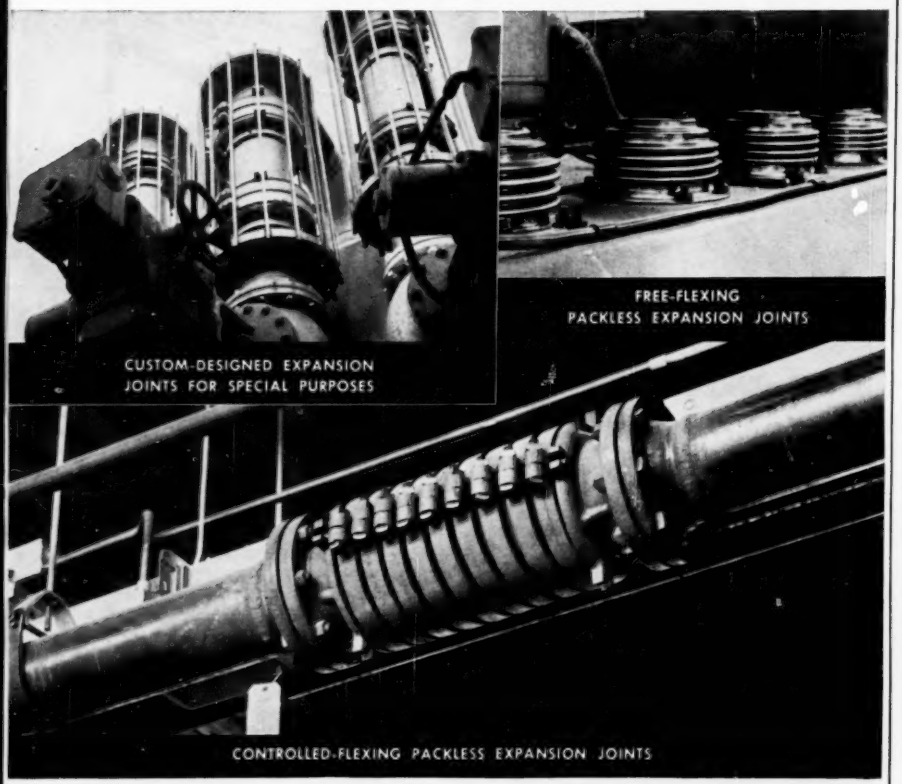
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evaporator calculations. . . . In the thermodynamics of solutions, he has been particularly active in the field of vapor-liquid equilibrium, a subject of tremendous importance in the petroleum and chemical industries."

This year, too, he was named chairman of the research division, southeastern section, of the American Society for Engineering Education.

▶ **His Post and Projects**—Jesse Coates is head of the chemical engineering department, Louisiana State University. Currently, he is also director of five major research projects:

- American Oil Co. research project in chemical engineering, "Diffusion Coefficients in Organic Liquids."
- Ethyl Corp. research project in chemical engineering, "The Thermodynamics of Solutions."
- Esso Laboratories research grant, "Direct Contact Heat Transfer."
- Engineering Experiment Station project, "Salt Cake Production by Modified Hargreaves Process."
- University sponsored research, "Thermal Conductivity of Solutions as a Function of Composition."

▶ **Over the years**—The record in the past has been just as imposing.

For one thing, he has authored some 23 meaty articles for books and technical publications on chemical engineering problems.

He is a past chairman of the Baton Rouge section of the AIChE as well as a charter member.

Since 1950, he has served actively on the Louisiana State Board of Registration for Professional Engineers and is currently secretary of the board.

On top of his 22 years or so on the faculty of LSU, he (along with LSU's Horton and Pressburg) has looked to the development of what LSU believes is the outstanding chemical engineering unit operations laboratory.

Besides an imposing list of active memberships, Coates is also active in LSU's engineering experiment station activities.

▶ **At Home**—Something of a do-it-yourself man (as Coates put it) the LSU professor spends a lot of time in his home workshop. Armed with a band saw, lathe, table saw, jointer and many hand tools, he converted his attic into living quarters. Current project is something for daughter, Judith. She's studying architecture at LSU and needs a good large work table for assembling her various models and drawings.

Coates is something of a barbecue chef too. He likes to get the family outdoors on nice evenings for one of his specialties —Southern style of course. The barbecue pit, he confesses, "isn't much to look at but re-

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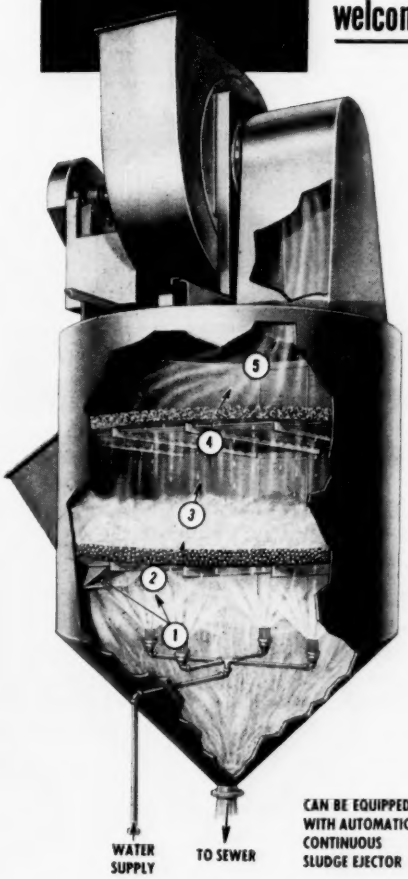

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3 Air is converted to bubbles in pool of violently turbulent water and mist maintained above filter bed. Small dust particles are trapped in water droplets.

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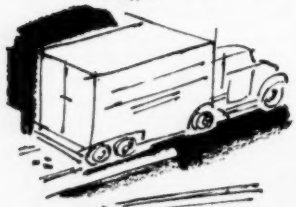

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sults are what count. And if I do say so myself, the meat and chicken are mighty good."

With a camp on the Amite River, a 14-foot run-about and a 22-foot cabin cruiser, Coates and the family manage to get in a little outdoor fun and just plain loafing. And, when he doesn't get out with the family, he often goes camping with the Boy Scouts: He's chairman of a local troop committee.

Right now, he's also merit badge counselor in chemistry for the Scouts' Istrouma Area Council. Recently, he set up a small lab in his garage where he often finds himself helping some small boy bone up for the chemistry merit badge.

Obviously, not one to loaf much, Coates is also active in the St. James Episcopal Church and has served on the vestry. He's active in the men's bible class and, now and then, fills in as teacher.

Jack H. Dollinger

Ferro Chemical Corp., Bedford, Ohio, wholly owned subsidiary of Ferro Corp., has elected Jack H. Dollinger as vice president-general manager and as a member of the board of directors.

Since last November, Dollinger has been serving in the capacity of acting general manager of the chemical firm. He has been with the Cleveland firm for the past two years.

Dollinger earned his bachelor's degree from Brooklyn College. He also holds a master's from NYU.

He is a fellow of the American Institute of Chemists.

Raeto Schett

Hoffmann-La Roche Inc. has named Raeto Schett as vice president in charge of its technical department. He succeeds **Albert J. Frey** who has retired from the post after 42 years of service.

The new technical department vice president, who was also named a member of the board of directors and of the executive committee, has been with Roche in Nutley since May 1956.

For the past two years, he has been Frey's assistant. Before that time, he was vice director for the firm in Switzerland.

Schett has been associated with Roche since 1944, when he received his Ph. D. from the Swiss Federal Institute of Technology in Zurich. Posts have included plant and development chemist and assistant to the technical general manager.

Edward W. Larsen has been promoted to the new position of manufacturing manager for S. C. Johnson & Son, Racine, Wis. Larsen has been production manager for Johnson's since 1954. He is a former production supervisor for Proctor & Gamble.

Stanley I. Raider has joined the research and development staff of Hooker Electrochemical Co., Niagara Falls, N. Y. He is a member of the plastics research applications group.

John Winterhaler has been appointed assistant to works manager of Electro Metallurgical Co. Division of Union Carbide Corp. He will make

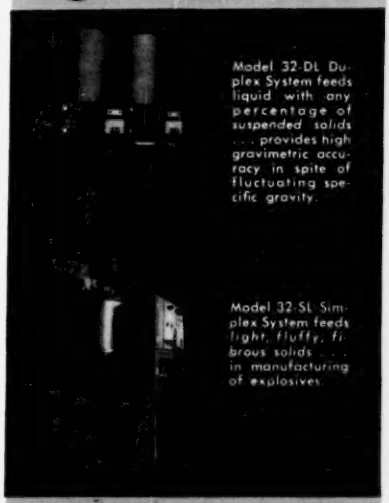
POSITIVE CONTROL OF MATERIALS IN MOTION BIF

New gains in ACCURACY...

with Omega Continuous Loss-in-Weight Feeding Systems

Accurate feeding of solid and liquid materials is the key to successful, economical continuous processing. Using the most advanced engineering principles, Omega Model 32 Continuous Loss-in-Weight Feeding Systems outperform ordinary feeding methods by setting accuracy standards never before attainable. That's why more and more processes are depending on Omega:

Model 32-SL Simplex System accurately feeds volatile liquid food flavoring. Total charge is contained in small tank.



Model 32-DL Duplex System feeds liquid with any percentage of suspended solids . . . provides high gravimetric accuracy in spite of fluctuating specific gravity.

Model 32-SL Simplex System feeds light, fluffy, fibrous solids . . . in manufacturing of explosives.

Model 32-DS Duplex System feeds floodable, granular, or cohesive solids (carbon black, sugar, salt, vegetables, etc.) . . . can be furnished with sanitary construction.

ACCURACY:
Guaranteed ±½% by weight of *set feed rate* (NOT of "full scale load" as many other systems are rated).

AUTOMATIC CONTROL:
A full closed loop . . . with feedback and memory features.

FLEXIBILITY:
Handles difficult materials easily — granular, floodable, slurries, volatile, explosive, others. Typical examples are shown at left.

AUTOMATIC SELF-CALIBRATION:
No sampling required. Totalizes weight delivered. Positively prevents cumulative over or underfeeding.

VERSATILITY:
Feeds *any* flowable solid or liquid material by proper selection of feed mechanism.

CAPACITY:
Simplex and Duplex Systems to feed 1#/hr. to 60,000 #/hr.

RANGE:
As required: 10:1 up to 50:1

NEW BULLETIN

32-R2 describes Omega Continuous Loss-in-Weight Feeding Systems — their design, operation, capacities, dimensions, and applications. Write for your copy, today.

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B-I-F INDUSTRIES BIF METERS FEEDERS CONTROLS

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SYSTEM*
offers every one
of these important
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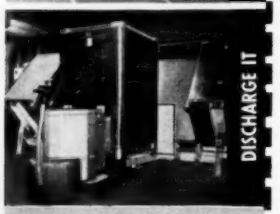

Tote System is a complete, mechanical, automatic bulk handling system. It is based on metal bins—aluminum, stainless or carbon steel, monel, or magnesium—plus filling and discharging equipment. Here is what it will do:

1. Tote System effects important economies by eliminating recurring container costs; eliminating product loss, contamination and deterioration; reducing labor and handling costs; reducing warehouse storage space requirements; and preserving original product quality.
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4. Tote System permits you to weigh incoming materials as a check against invoice weight, and for a permanent inventory record.
5. Tote System permits the use of a minimum, uncomplicated conveyor system with an accompanying reduction in clean-up and maintenance time.
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9. Tote System, in small and medium sized installations, requires no more labor to operate than a fixed storage bin system. In extremely large installations, another man may be required, but, in most cases, his time is more than offset by the elimination of highly-paid electronic experts needed to maintain and operate complicated fixed bin storage and conveying systems.

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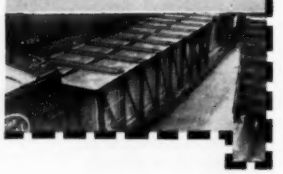
Railroad Container Cars with either 26 or 28 Tote Bins on a car are available on lease arrangement. One man can unload the car in 35 minutes, using a lift truck. A mileage allowance of 3.7 cents is paid for every mile this car travels.



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NAMES . . .

his headquarters in New York, where he replaces **D. E. Stingel,** recently transferred to Union Carbide Olefins Co.

Charles Sattes, Jr., Charles A. Thomas and **William Reynolds,** project engineers in construction of Callery Chemical Co.'s new Lawrence, Kan., plant, have been transferred from the company's research and development division at Callery, Pa., to Lawrence, where they will be supervisors.

Paul J. La Marche

U. S. Industrial Chemicals Co. has named Paul J. La Marche director of production, in New York.

Since 1951, La Marche has been manager of the firm's Ashtabula, Ohio, plant. Before that time, he had been manager of sodium sales.

La Marche is a Case Tech graduate from the class of 1940. After finishing school, he joined Allegheny Ludlum Steel Corp. In succeeding years, he worked for Du Pont's electrochemicals department and the Lebanon Steel Foundry in various supervisory and technical sales activities.

When he joined National Distillers in 1949, he was works manager for the Premier Mill Corp., in Geneva, N. Y.

Terry W. Tarkington has been named head of the solution spinning section in the pilot plant operations of Chemstrand Corp.'s research and development division. He was with Carbide and Carbon

Chemical Co., South Charleston, W. Va., before joining Chemstrand in September, 1956.

Paul D. Foote's nomination as Assistant Secretary of Defense for research and engineering has been approved by the Senate Armed Services Committee. Foote is a retired oil industry executive, former vice president of Gulf Oil Co.

Donald E. Alguire has been appointed to the research staff of Borden Co.'s special products division. He has been assigned to the division's product development laboratory, Elgin, Ill., as a food technologist.

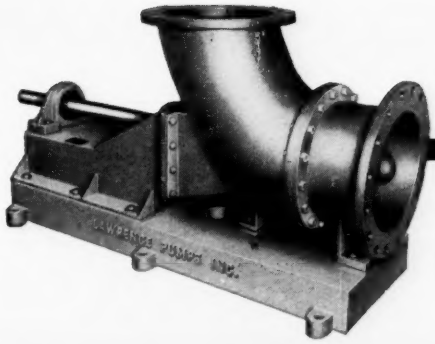
Robert B. MacMullin

The 1958 Jacob F. Schoellkopf Medal of the Western New York section of the ACS has been awarded to Robert Burns MacMullin—senior partner of R. B. MacMullin Associates, consulting engineers of Niagara Falls, N. Y.

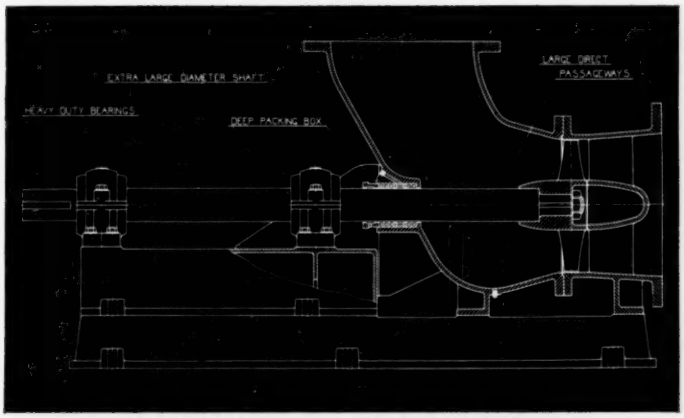
The award goes to MacMullin "for his original contributions to the science of chemical engineering and for his achievements at home and abroad as a consulting engineer, particularly in the field of industrial electrolytic processes."

MacMullin was born in Philadelphia in 1898. He attended Bowdoin College and graduated in chemical engineering from MIT in 1919.

During World War I, he served in France with the Chemical Warfare Service. Until the close of World War II,



Lawrence 24" Horizontal Circulating Pump of Nickel Alloy Construction



Cross Section of Lawrence Horizontal Propeller Pump

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Lawrence Propeller or Axial Flow Pumps are widely used to circulate large volumes of liquid or slurry against low heads as in evaporators, crystallizers, etc. This type of pump is particularly well adapted for circulating service because of its simplicity, high efficiency, and low first cost. The flow can be arranged in either direction and the casing turned to any position desired to serve as an elbow. The capacity can be closely regulated by varying the speed—very important in crystallization processes where a uniform velocity must be maintained.

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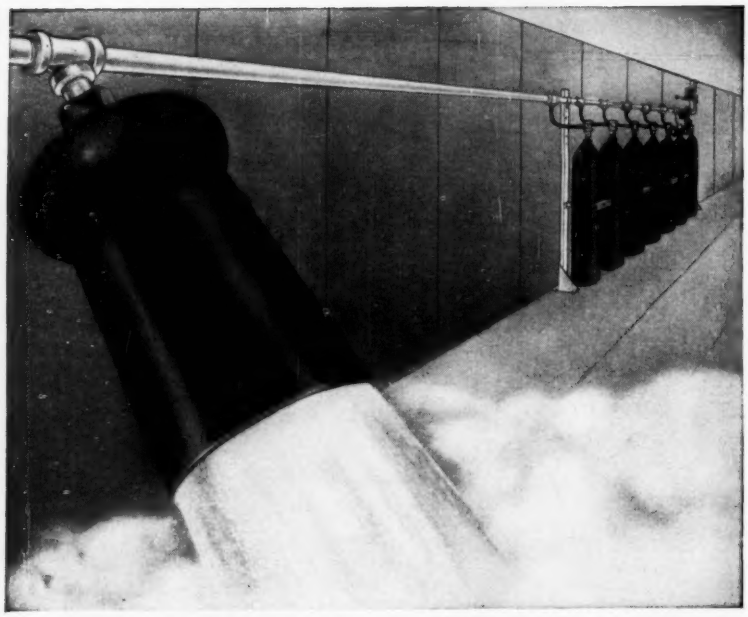

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Because they use dry, clean non-damaging carbon dioxide as an extinguishing agent, Kidde systems can be installed to protect intricate machinery or delicate electrical equipment. Carbon dioxide smothers fire the instant it starts, then vanishes quickly into thin air. It leaves no mess, no clean-up job afterwards!

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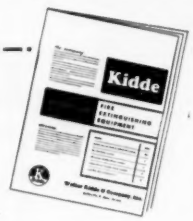
For more information on Kidde systems, and how they can protect your plant from fire, send the coupon or write today for Kidde's Engineered Fire Equipment Booklet.



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he worked for Olin Mathieson's predecessor: Mathieson Alkali Works, Inc.

His consulting practice, begun in 1946, specializes in process engineering, particularly in the design of chlor-alkali plants and other electrolytic processes.

Ira Kukin

Sonneborn Sons, Inc., has named Ira Kukin as research director of the firm's Belleville, N. J., plant.

In the new post, he'll be in charge of research and development on petroleum and textile products.

Kukin joined the firm last year as liaison chemist in the department of industrial research. He came to Sonneborn after six years with Gulf Oil, where he worked as a group leader in charge of fundamental research. Before joining Gulf, he served as an instructor on the faculty of Sampson College, Geneva, N. Y.

Educational background includes a bachelor's degree from City College, a master's and a doctorate from Harvard.

John D. Harper, Jr. succeeds Martin H. Styles, who has been transferred to Philadelphia, as chemical sales representative in the Buffalo-Pittsburgh area for Barrett Division, Allied Chemical & Dye Corp.

Norman A. Barthelson has been named senior chemical engineer in the process engineering section of Atlas Powder Co.'s chemical engineering department. Barthelson was

engaged previously in research and development work and process and production engineering with Hercules Powder Co.

Robert C. Burnham has been appointed to the post of plant engineer at Air Reduction Chemical Co.'s Calvert City, Ky., works.

Emil R. Gazdik, former sales engineer for Evans Winter Hebb Inc., Detroit, has joined Automatic Molding Machine Co. division of Wagner Brothers Inc., Detroit as Eastern regional engineer.

D. E. Lintala

Goodyear Tire & Rubber Co. has named D. E. Lintala as technical superintendent of the firm's new $9 million Videne polyester film plant at Apple Grove, W. Va.

Formerly on the research engineering staff, Lintala has been associated with Goodyear since 1942 when he joined the production training squadron. Since that time, he has held various chemical engineering posts with the firm including: chemical training supervisor, chemical plant supervisor and section head of the chemical engineering division.

A native of Fairport Harbor, Ohio, Lintala graduated from Ohio State University in 1942 with a bachelor's degree in chemical engineering.

Carl Pacifico, vice president of American Alcolac Corp., Baltimore, has been elected to the company's board of direc-

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DRY DUST CONTROL

If you're airing a dust control problem for industrial process or community relations . . . consider the factual benefits of field-proven Ducon Cyclones for dry collection. Hundreds of leading plants throughout the world, handling a wide variety of products, have found that Ducon dry-type collectors provide the continuous operation needed to capture nuisance dusts and recover usable product . . . most effectively, and with no processing down-time for sludge clearance. Consult a Ducon field engineer who may have a ready answer for your specific dust control problem.

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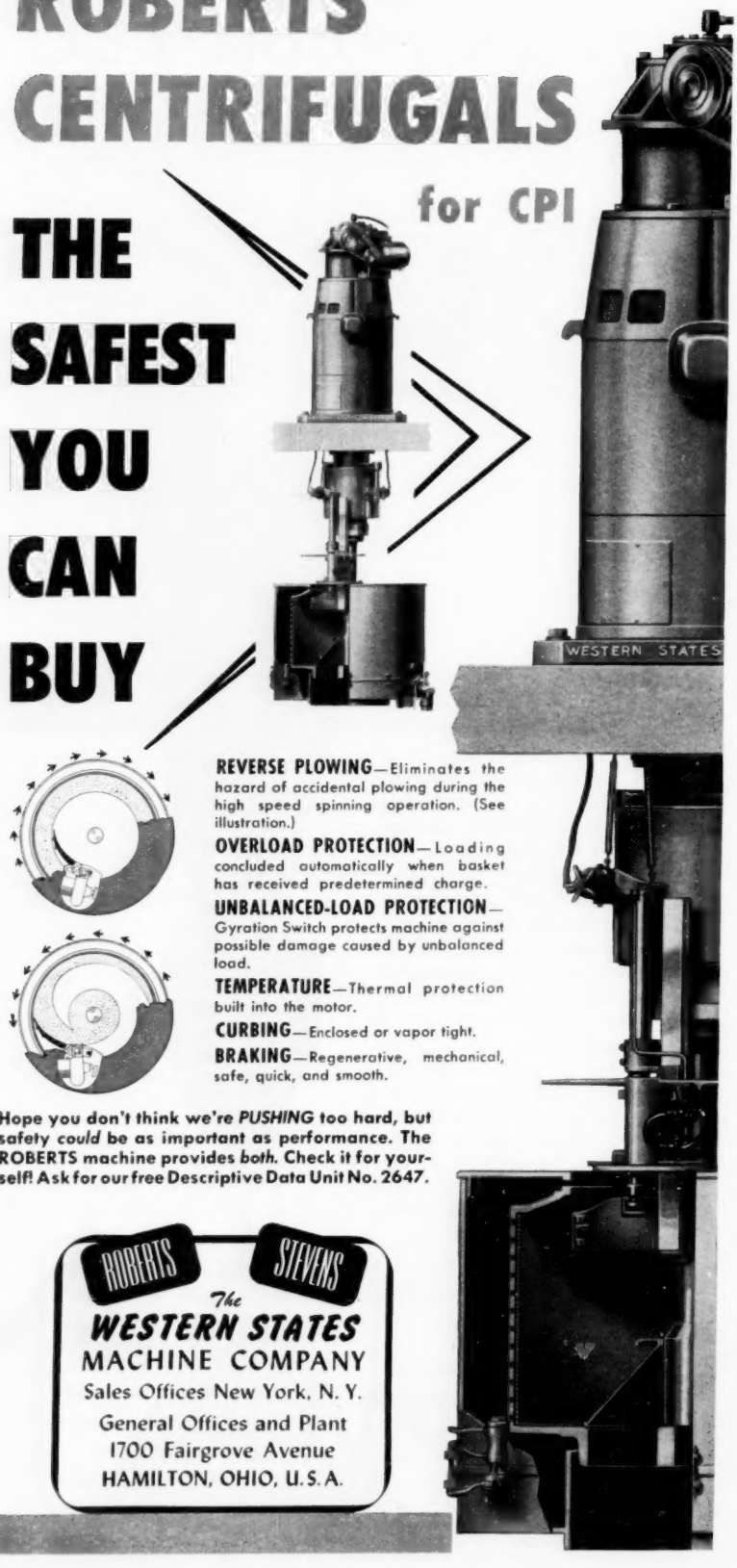

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tors. Pacifico joined Alcolac in 1954 and was named vice president last year.

Rene Durr, formerly in charge of Reichhold Chemical's technical service department at the Elizabeth, N. J., plant, is now western region manager of the emulsion division.

J. J. Williams is now manager of the Parke, Davis & Co. branch in Panama, with headquarters in Colon.

OBITUARIES

Kenneth R. Brown

Retired vice president of Atlas Powder Co., Kenneth R. Brown, 61, died March 18 in West Chester, Pa., following a long illness.

Brown, who played a key role in the firm's entry into the chemicals field, retired as vice president and director in 1956 after 38 years of service.

Brown's work with sorbitol, one of the firm's best known products, won him the 1955 honor awards of both the Commercial Development Ass'n and of the ACS' division of carbohydrate chemistry.

His work on the conversion of sugar to hexitols made the firm's Atlas Point plant, near Wilmington, the nation's largest industrial user of sugar for chemical synthesis.

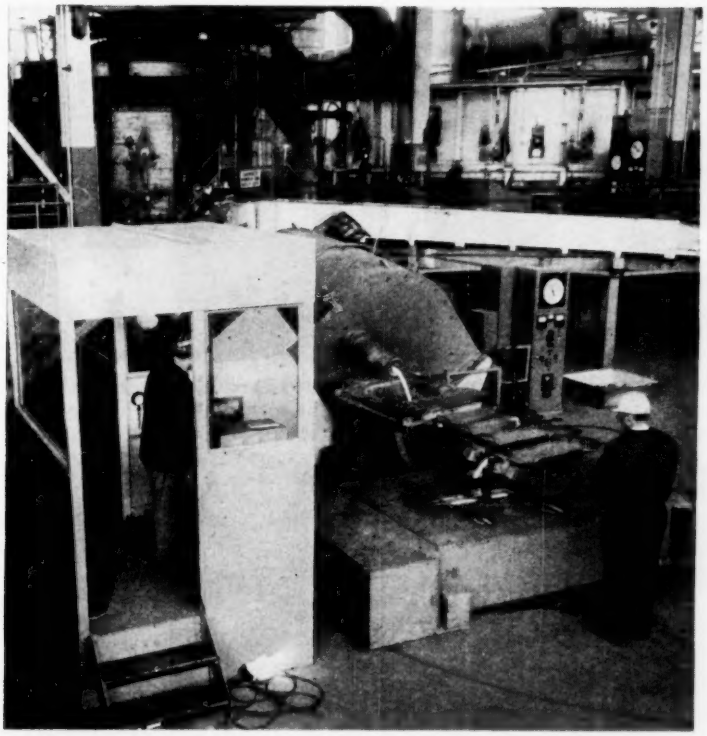
Donald E. Sharp, internationally known glass technologist, died March 29 in Toledo, Ohio. Sharp had been vice chairman of Libbey-Owens-Ford Glass Co.'s permanent technical policy committee since 1955.

PEOPLE . . .

FIRMS IN THE NEWS

R. A. LABINE

NEW FACILITIES



Longest Copper Cakes From New Casting Facility

American Smelting & Refining Co. now casts its copper cakes in 25-ft. lengths, claims substantial savings for new method. Cake-casting unit is second of a three-phase building project at the Perth Amboy refinery: Already in operation is a wire-bar casting wheel. Scheduled for later completion is a continuous billet casting unit; all operations will be supplied with molten copper from 30-ton/hr. arc furnace in background.

Kaiser Aluminum & Chemical Corp.'s new $8-million caustic-chlorine plant at Gramercy, La., is now tuned up to full capacity—114 tons caustic soda and 100 tons chlorine per day. Caustic is piped to Kaiser's Baton Rouge alumina plant and the reduction works at Chalmette, La., for synthetic cryolite production. Olin Mathieson is marketing the chlorine output under long-term contract.

Canadian Industries Ltd.'s new $3-million sulfuric acid plant at Copper Cliff, Ont., is now in production serving area's uranium mines. Raw material, 40,000 cfm. SO_2-bearing gases, comes from International Nickel Co.'s iron ore recovery plant; this is second C-I-L acid unit using Inco smelter gases. New plant is rated at 300 tons/day acid.

Du Pont has started up its new sulfuric acid plant at Escorse Mich., near Detroit. Report-

SUPERVISORY CONTROL

New remote operation economy regardless of control distance for:

- power distribution
- motors
- valves
- pumps
- industrial water systems
- any piece of electrical apparatus which has provisions for local control

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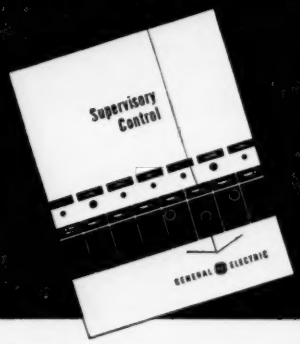

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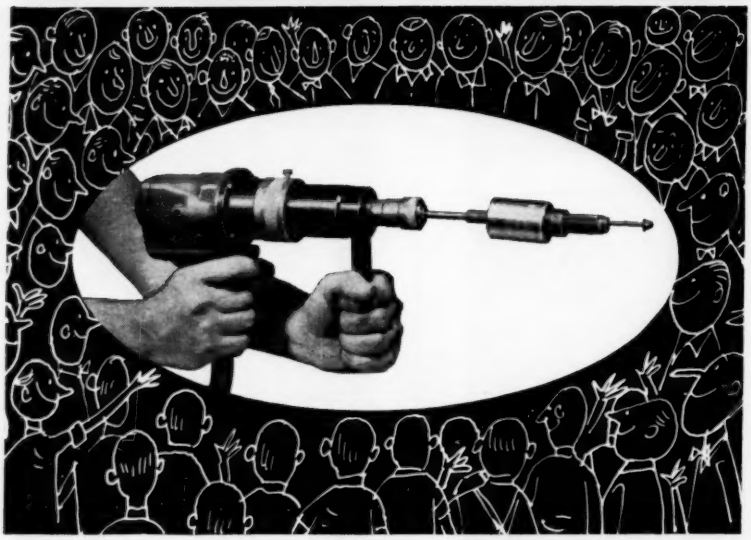
The New ELLIOTT Air Magnetic Control...

for tube expanding in hazardous locations



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Y8-3

edly, plant's capacity is twice as much as the two older plants in the area that are now being dismantled. Escorse Works will produce acid in all strengths for automobile, steel, petroleum and chemical industries.

Leach Corp., Los Angeles, Calif., has erected a new plant in the suburban Compton area at a cost of $1.5 million. Shown above are manufacturing operations for support vehicles for new interceptor aircraft.

Solvay Process Div. of Allied Chemical has doubled vinyl chloride monomer capacity at Moundsville, W. Va. Monomer is produced by a process developed and engineered by Allied; raw materials, anhydrous HCl and acetylene, come from adjacent production units.

Eagle-Picher Co. is building a $2-million diatomaceous earth plant at Lovelock, Nev., about 25 mi. from firm's open-pit mine. Slated for completion in August, plant will have capacity of 36,000 tons/yr. natural and calcined filter aids. Kaiser engineers are designing and building.

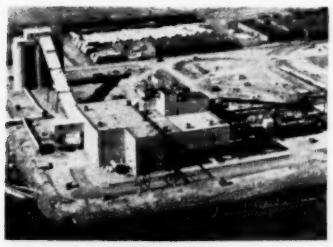
Sun Oil Co. is starting construction on a $500,000 district terminal off Bramers Lane near Louisville, Ky., on the Ohio River.

Dorr-Oliver is supplying design and engineering for the first triple superphosphate plant to be built in Mexico. Tentatively scheduled for startup early in 1960, plant will use Dorrco granular fertilizer

and Dorrco strong phosphoric acid processes. Plant, near Coatzacoalcos, Veracruz, will import phosphate rock from Florida.

Gulf Oil has placed its second Platformer on stream at its Philadelphia refinery. Unit, 26,000-bbl./day capacity, was designed by Universal Oil Products and erected by Procon, Inc.

Davison Chemical announces addition of run-of-pile triple superphosphate facilities to its Bartow, Fla., plant. Run-of-pile, a powder form, will be added to plant's output of granulated triple superphosphate. Additional process does not raise plant's overall capacity which is rated conservatively at 200,000 tons/yr.

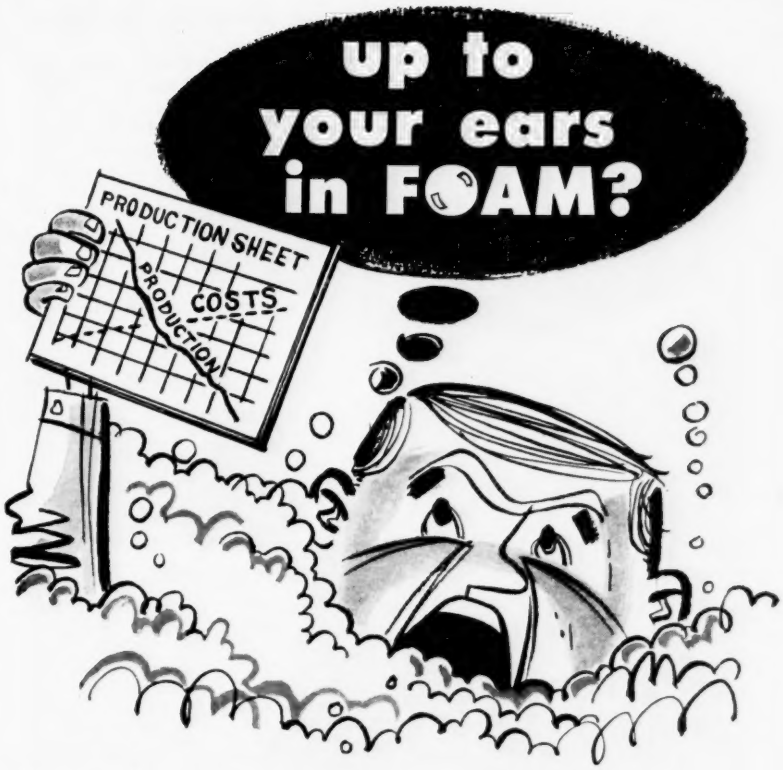


Rayonier's new $4-million woodmill at Hoquiam, Wash., has swung into full operation. Mill can turn out dry wood chips at a 100-ton/hr. clip, is designed to handle 3.5-in.-dia. sticks up to 5.5-ft.-dia. giant logs. Flexibility will contribute greatly to wood conservation in the area.

Yale Univ. has started operating a giant new atom smasher at New Haven, Conn. Officially titled Heavy Ion Linear Accelerator, the $1.8-million accelerator was financed by the AEC.

Royal Dutch Shell has just opened an alkylate plant at Pernis, near Rotterdam, Holland. Unit, which will produce components for aviation gasoline, is the first of its kind in Western Europe.

National Research Corp., Cambridge, Mass., has been



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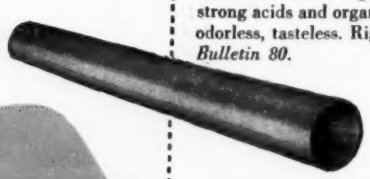

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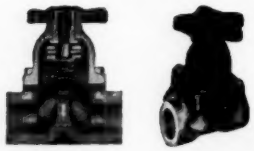
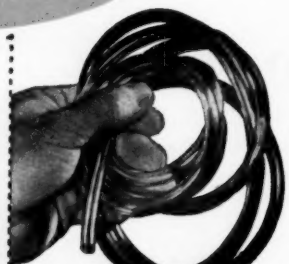
VALVES

for all-plastic piping systems

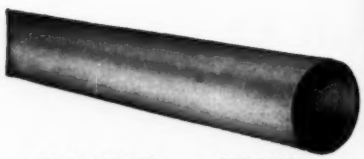


Trouble-free plastic diaphragm valves . . . choice of general-purpose ACE-ITE, ACE PARIAN (polyethylene) or ACE SARAN. Handles most corrosive chemicals and food ingredients. Sizes ½" to 2", 50 psi. at 77 deg. F. *Bulletins 80 and 351.*



1001 USES *for ACE-FLEX Tubing*

Excellent chemical-resistant, all-purpose flexible plastic tubing. Sparkling clear, easy to clean, odorless, non-toxic, can be steam-sterilized. ⅛" to 1" ID. *Bul. 66.*



RIGID VINYL . . . STRONG, AGE-PROOF

ACE RIVICLOR is a new rigid threaded plastic pipe with good aging and high impact strength. Not affected by most inorganic acids and alkalis, also excellent for many organics. Sizes ½" to 4". *Ask for Bulletin CE-56.*

ACE processing equipment of rubber and plastics

AMERICAN HARD RUBBER COMPANY

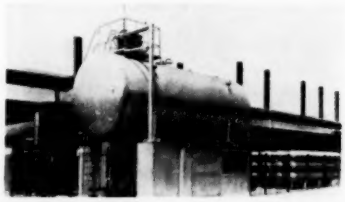
Ace Avenue • Butler, New Jersey

DIVISION OF AMERACE CORPORATION

FIRMS . . .

awarded a half-million-dollar government contract to design, build and test operate a large vacuum furnace for melting titanium. The quarter-ton unit will be built for the General Services Administration that controls this country's titanium stockpile.

Merck Sharp & Dohme International recently opened a large new medicinal chemical and pharmaceutical plant in Brazil. Constructed at a cost of several million dollars, plant occupies a 25-acre site.



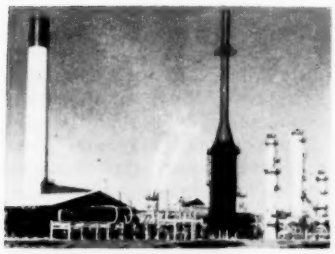
Linde has installed new liquid nitrogen supply facilities at Houston, Tex., and Tulsa, Okla., storing nitrogen as a liquid in order to save on storage and handling costs. These giant "thermos bottles" must maintain temperatures below −320 F.; capacity of both units is around 1 million cu. ft. nitrogen.

Hercules Powder Co. owns a major interest in a new Mexican chemicals plant that recently started up near Ciudad Hidalgo, Michoacan. Estimated annual capacity is 25 million lb. rosin, turpentine, pine oil and other turpene chemicals.

American Cyanamid has started up its multimillion dollar aniline plant at Willow Island, W. Va. Plant, rated at 24 million lb./yr., is built around entirely new process: Catalytic reduction of nitrobenzene in a fluid-bed reactor.

Great Lakes Oil & Chemical Co. plans to establish a new research department for its chemical division. To be located in LaFayette, Ind., facility will develop new products and processes for the Filer City, Mich., plant.

Beckman Instruments has installed a fully transistorized automatic process monitoring system at Socony Mobil Oil's Casper, Wyo., refinery. New electronic system monitors operation of a catalytic reformer turning out 3,500 bbl./day high-octane gasoline.



Tidewater Oil Co.'s Avon refinery near Martinez, Calif., sports a new 22,500-bbl./day platinum catalytic reformer. This is the second reforming unit at Avon and is designed for future expansion to 45,000 bbl./day.

Hercules Powder Co. has started construction on a "major facility" for development and production of solid propellants for long-range rockets and missiles. Located on a 500-acre site at Bacchus, Utah, plant will employ latest methods for casting double-based (nitrocellulose and nitroglycerine) solid fuels.

Electric Reduction Co. of Canada is starting production of organic phosphates at its Buckingham, Que., plant; firm is also expanding sodium chlorate capacity at Buckingham. At the same time, company is boosting sodium chlorate capacity in North Vancouver by 50%.

Carmer Industries, extruders of Kel-F., nylon and Teflon, located in Kenilworth, N. J., are doubling plant facilities and adding more laboratory space.

Imperial Chemical Industries, British chemical giant, plans to erect a Terylene polyester fiber plant in Northern Ireland if demand develops as expected. Planning and con-

STAYS TOUGH AT SUB-ZERO TEMPERATURES

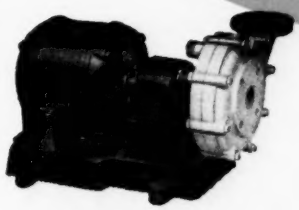
Ace Parian . . . odorless, tasteless, rigid polyethylene. Best chemical resistance of any plastic at room temp. except to acetic acid. Excellent impact strength at sub-zero temp. Rigid pipe ½" to 2". *Bul. 351.*

LIFE-TIME ACID STORAGE TANKS
Rubber-lined by ACE 2-layer system

Economical, universal protection against all alkalis, metallic salts, practically all inorganic acids, hydrochloric acid any strength, sulphuric to 50%, nitric to 20%, phosphoric to 75%. Good to 160 deg. F. . . . sometimes higher. Soft rubber interlayer aids shock resistance.

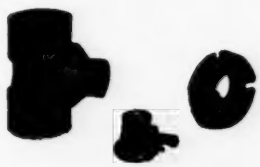
Now eleven ACE Materials to STOP CORROSION

Eleven job-proved rubber and plastic materials now available in ACE piping, valves, pumps and tanks. Tough Ace-lite rubber-plastic blend . . . Saran . . . heat-resistant Tempron . . . Rivicior PVC . . . many others. Write for comparative properties Bulletin CE-50 . . . or call your American Hard Rubber Company distributor.



ACE "WAM" . . . THE FINEST
Non-metallic Acid Pump

On job after job, this 80-gpm. centrifugal pump has earned highest praise. Hard rubber casing and impeller, Hastelloy C shaft. Handles nearly all corrosives. Mechanically simple, trouble-free. *Bulletin CE-55.* Larger Ace pumps available.



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If you want life-time corrosion protection for special parts needed in quantity . . . we may save for you by molding them of Ace hard rubber or plastics to your most exacting requirements. Our facilities among world's largest. Ask for recommendations.

ACE processing equipment of rubber and plastics

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GARDNER DENVER

Gardner-Denver Company, Quincy, Illinois.

In Canada: Gardner-Denver Company (Canada), Ltd., 14 Curity Avenue, Toronto 16, Ontario.

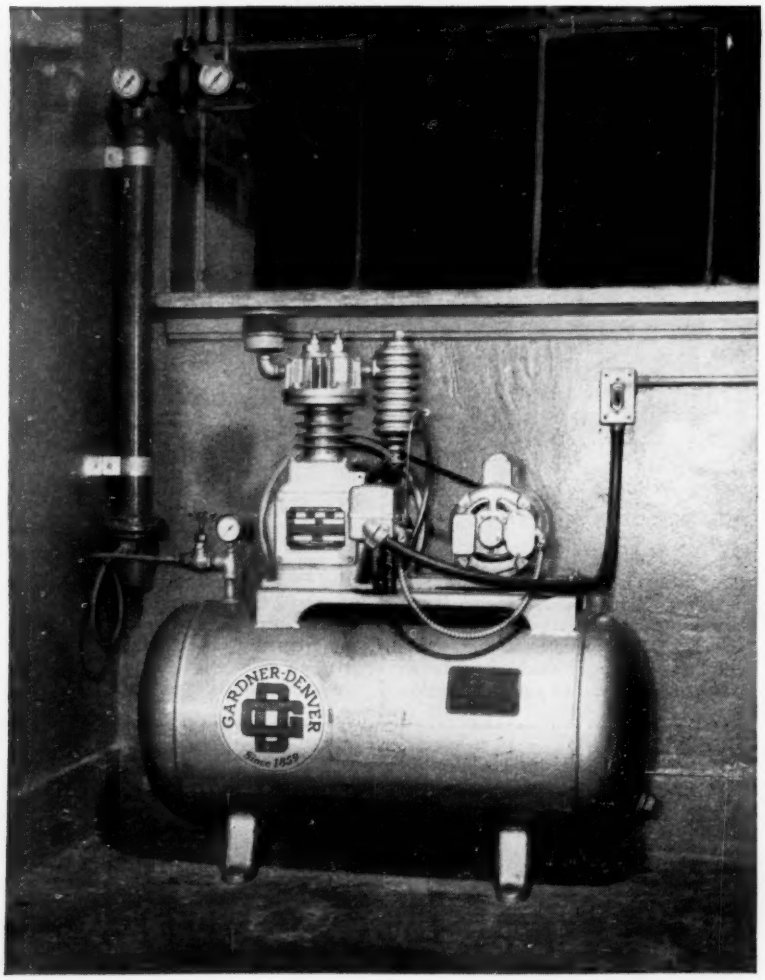
Hook up a small and compact Gardner-Denver CACB compressor and be sure of the pure, oil-free air you need for instrumentation, processing or the manufacture of chemicals.

The CACB uses no oil in the cylinder. Pistons and piston rings are made of self-lubricating carbon—no oil or water lubrication required. This highly efficient compressor supplies four to five cu. ft. of low-cost oil-free air per min., with discharge pressures from 40 to 100 psi. Write for complete information.

Stationary air compressors . . . tank-mounted compressor outfits . . . oil-free air compressors—whatever your compressed air needs, see your Gardner-Denver compressor specialist first. Gardner-Denver Company, Quincy, Illinois.

Low-cost . . . oil-free air

Compact CACB compressor



struction will take several years, but ICI hopes to be in production by 1964.

Square D Co. and Electric Controller & Mfg. Co. are building a 10,000-sq.-ft. regional headquarters building in Pittsburgh, Pa., for combined activities of both companies.

Chemische Werke Huels, in Marl, Germany, is building a polyethylene plant with monthly capacity of 500 tons, slated to start up in second quarter of 1959. Plant is being built around Ziegler low-pressure process. Huels is also experimenting with polypropylene; expects to be able to offer sample quantities in near future.

General Aniline's Ozalid Div. has officially opened its new million-dollar plant in La Habra, Calif., for manufacture of sensitized materials for copying machines. Plant boasts total area of 82,600 sq. ft.

Red China's first polyethylene plant is now underway in the southern metropolis of Canton. Scheduled for completion in fourth quarter of 1958, plant's initial output has been pegged at 60 tons/yr.

Parke, Davis & Co. has broken ground in Menlo Park, Calif., for firm's new branch office and warehouse. When completed in September, building will total 34,000 sq. ft. and will have cost about $690,000.

American Cyanamid is consolidating its mining chemicals and explosives sales activities into a new unit to be called explosives and mining chemicals department. New department will become part of firm's Organic Chemicals Div.

National Cylinder Gas is changing its name to Chemetron

Corp., subject to official stockholder approval; change comes because firm had "outgrown" old title. New name derives from words *chemicals, metals* and *electronics* which describe company's major activities.

NEW LOCATIONS

Emery Industries has moved its Philadelphia sales office to 4343 East River Drive. Products handled by office include fatty acids, hydrogenated glycerides and special monobasic and dibasic acids.

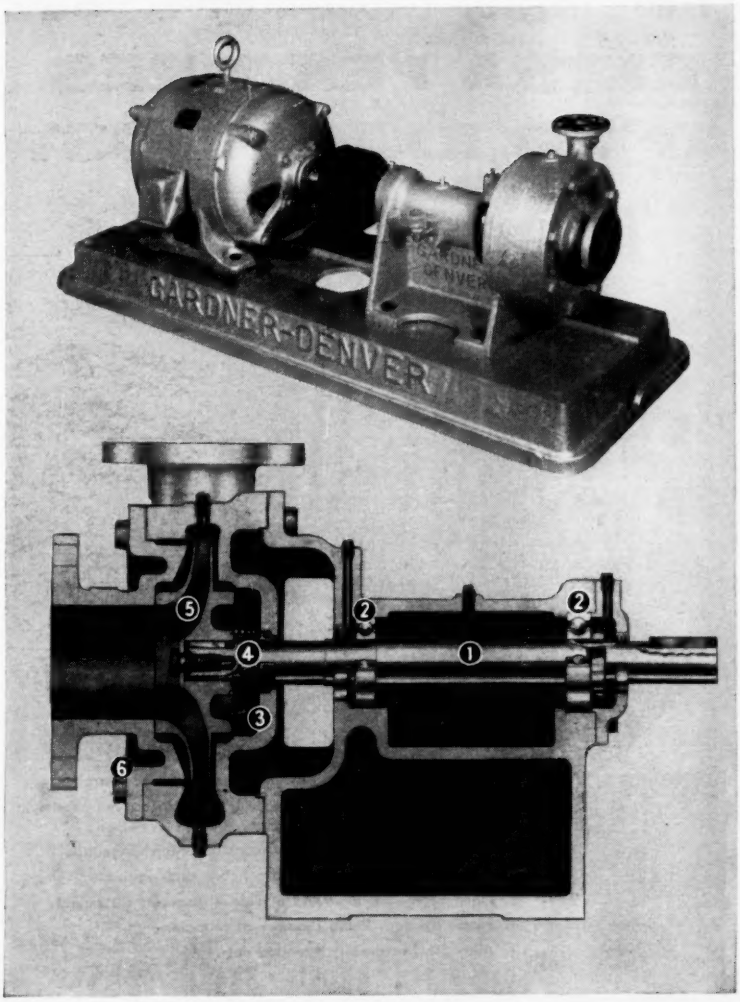
DeMert & Dougherty's Chicago facilities have been consolidated on an 11-acre tract at 5000 W. 41st St. Two barges with 250,000 gal. and 360,000 gal. capacities as well as 5 million gal. of liquid storage facilities are in operation at the new location.

Strom Steel Ball Co. has transferred executive offices and plant facilities from Cicero, Ill., to a completely new plant in Erwin, Tenn.

MERGERS & ACQUISITIONS

Howe Sound Co. and Haile Mines, Inc., are planning to merge, subject to stockholder approval. William M. Weaver, Jr., president of Haile Mines has also been elected president of Howe Sound and will assume direction of combined companies. Net assets of the combine will be over $29 million.

Alex C. Fergusson Co., Philadelphia chemical manufacturer, has acquired the Philadelphia plant of Penco Metal



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determines centrifugal pump performance

Choose new Gardner-Denver BH centrifugal pumps, engineered for high speed, high head, high output. Here's why:

1. Stainless steel shaft.
2. Heavy-duty ball bearings.
3. Casing of high-strength alloy iron produces gradual velocity changes for smooth flow, better efficiency.
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5. Hydraulically balanced bronze impeller.
6. Casing cover readily removed for impeller inspection.

Four sizes provide capacity range from 55 to 520 gallons per minute. Send for Bulletin 2-2e.

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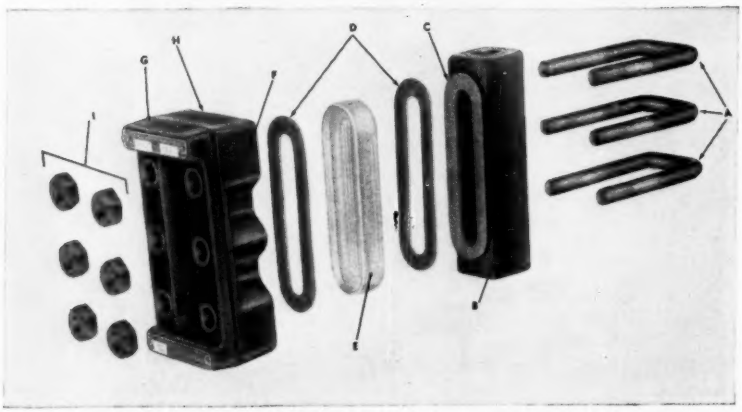
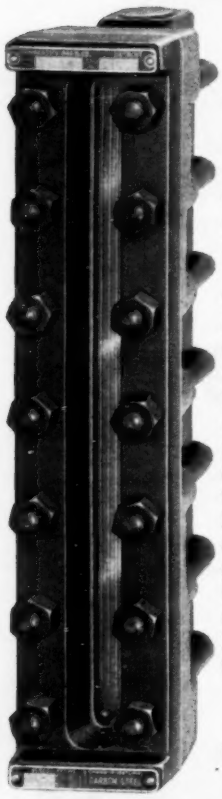
CLEAR, ACCURATE LIQUID-LEVEL READINGS
in all tanks, boilers, vessels, containers, flow lines.



PENBERTHY REFLEX GAGES TYPE V & S



A Alloy Steel Bolts for high temperature service.
B Alloy Steel Liquid Chamber heat treated . . . no warping.
C Raised Face on Liquid Chamber insures perfect self-alignment of frame with glass and gasket.
D Composition Gaskets and Cushions are interchangeable.
F Drop Forged Steel Frame extra heavy and rigid.
G Extra heavy beam at end of Frame (prevents distortion).
H Frame overlaps liquid chamber at all points.
I Alloy Steel accurately threaded nuts.

The "inside story" of Penberthy Liquid Level Gage construction shows why you get positive-accurate readings at temperatures from sub-zero to over 750° F; up to pressures exceeding 10,000 psi.

Exclusive features assure long service (at no extra cost) in all types of applications . . . even with highly corrosive and dangerous chemicals. Maintenance is much simpler; replacements and repairs made without removing assembly from vessel.

Proved through extensive use, Penberthy gage sets are available, in bronze, iron, carbon steel, stainless, monel and other materials . . . from stock or specially designed by gage engineering specialists.

Catalog 36 details complete line including accessories. Please send request on business letterhead. No obligation, of course. Order through your jobber or direct.

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- ELECTRIC SUMP PUMPS
- CYCLING JET PUMPS
- INJECTORS
- EXHAUSTERS

products and will use the property for expansion of its adjoining plant. Purchase price: $133,900.

Flintkote Co. has purchased, for an undisclosed amount of cash, the Chimney Div. of C. A. McRobert & Son of Montreal, Canada. McRobert's Chimney Div. will continue to operate as a division of Flintkote Co. of Canada, with headquarters in Toronto.

Fulton Bag & Products Co. of New Orleans, La., is being absorbed through a cash transaction as a division of West Virginia Pulp & Paper Co. Fulton operates plants at New Orleans and St. Louis producing multiwall paper sacks, elastic multiwall sacks, waterproof paperlined bags and other specialties.

Union Tank Car Co. of Chicago has announced an agreement under which the firm will acquire all assets of The Lang Co. of Salt Lake City, Utah, subject to approval from both sets of stockholders. Lang supplies equipment and steel products for many phases of industry.

United Electric Controls Co., Watertown, Mass., has added Aerotech Specialties of Glastonbury, Conn., as a subsidiary. Acquisition broadens United Electric's scope in temperature and pressure control field.

Minerals Refining Co. of Salt Lake City has changed hands, controlling interest being purchased by Lee Aiken of Corpus Christi, Tex. Under new management, company will concentrate on exploiting low-grade beryllium ores and a process for making silica-free, synthetic cryolite.

Container Corp. of America has acquired Garmold, Inc., Totowa, N. J., through an exchange of stock. Garmold is a manufacturer of molded plastic products.

Philadelphia & Reading Corp. has paid out $4.5 million in

cash for assets and business of Shuron Optical Co., Geneva, N. Y. This is the third major acquisition by Philadelphia & Reading since the present management took over some two years ago.

Le Roi Div. of Westinghouse Air Brake Co., Milwaukee, Wis., has sold its engine business to Waukesha Motor Co. of Waukesha, Wis. Le Roi disposed of its engine line to concentrate on air compressor and tool business.

Hyster Co. of Portland, Ore., and Martin Machine Co. of Kewanee, Ill., have merged. Corporate change will not have any effect on names or location of present Hyster operations.

NEW REPRESENTATIVES

Catalysts & Chemicals, Louisville, Ky., has taken a license from National Cylinder Gas' Girdler Div. covering substantially all of Girdler's know-how and trade secrets in field of specialty catalysts including development and manufacturing information.

R. S. Norris Associates, fuel and lubricants consultants of Larchmont, N. Y., have appointed Beckley, Halton & Hickman of New York City as export agent for sales and technical assistance in application of Barsad fuel additives for the oil industry.

Fibreboard Paper Products Corp., San Francisco, is now exclusive licensee for 11 western states and Alaska to manufacture and sell corrugated paperboard channels used in new wood-and-paperboard expendable pallets developed by Shipaway Div. of Bulldog Pallet Co., Newark, Calif.

Hamerslag Equipment Co. of San Francisco has been appointed northern California

The valve that outlasts the equipment!

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- Completely dependable for millions of cycles.
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Last longer than other valves... yet cost only $6.50

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VALCOR SV-4900 series...2.35" high by 1.50" wide...available 7/64 orifice rating 130 PSI max. and 5/32 rated 60 PSI max. ...for use with water, air, steam, inert gases, petroleum and vegetable oils, gasoline, kerosene and many other semi-corrosive media...and they are stocked for off-the-shelf delivery.

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SOLENOID VALVES

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W-S 150 lb. STAINLESS STEEL FITTINGS

Exceptional strength and perfect alignment are features you can rely on in W-S 150 lb. Stainless Steel Fittings. Because they resist corrosion, stand up to extreme heat and cold, they're ideal fittings to safeguard the processes of petroleum, chemical, food and other process industries.

Specify W-S screw-end and socket welding fittings. Available in sizes ⅛" to 4"...in every type you may need. Materials: Stainless Steel types 304 and 316. ASTM-A-182, Grade F-304, F-316 for forged fittings. ASTM-A-296, Grade CF-8, CF-8M for precision cast fittings.

Forge and Fittings Division manufactures a full line of high quality fittings, unions and couplets...in carbon, stainless and alloy steels. For information about them and for your commercial forging and die casting requirements, write to Forge and Fittings Division, H. K. Porter Company, Inc., Box 95, Roselle, N. J.

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Stainless Steel Works, Duncannon, Pa. • Cleveland Die Cast Works, Cleveland 4, Ohio

representative for Alvey Conveyor Mfg. Co.

J. C. Corrigan Co., manufacturer of heavy duty conveying systems, announces Pittsburgh Standard Building Corp. is now its agent in Pittsburgh, Pa., market area. Corrigan headquarters are in Boston, Mass.

Tube Turns Plastics, Louisville, Ky., has granted BTR Industries, London, the right to manufacture unplasticized polyvinyl chloride products by firm's Hendry process.

NEW LINES

Trane Co., long-time manufacturer of air conditioning equipment for big building applications, will enter residential year-round air conditioning market in mid-1958 with a wide line of central home heating and cooling products.

NEW COMPANIES

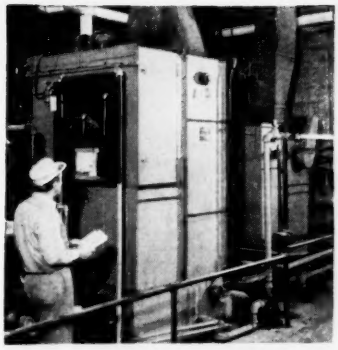
Mason Products, with headquarters in West Concord, Mass., has been organized to enter the water cooling tower field. Cooling towers ranging in capacities from 8 to 75 tons are now in production.

Norton Co. of Worcester, Mass., and Carbometal, S. A., of Mendoza, Argentina, have formed a new company to produce silicon carbide for Argentine market. Called Norton Casali, S. A., company will erect an electric-furnace plant on a ten-acre site in Mendoza. Construction on the $500,000 project is scheduled to get underway this month and be finished by end of 1958.

DRY and CLEAN AIR at the RIGHT TEMPERATURE

- to control your product quality
- to protect a critical operation
- to protect apparatus from moisture damage
- to DRY your material or product
- to control packing or storage conditions
- to assure precision in testing or research
- to increase air conditioning capacity

Air Condition by the NIAGARA Method Using HYGROL Liquid Absorbent



This compact method, giving high capacity in small space, removes moisture from air by contact with a liquid in a small spray chamber. The liquid spray contact temperature and the absorbent concentration, factors that are easily and positively controlled, determine exactly the amount of moisture remaining in the air.

Most effective because... it removes moisture as a separate function from cooling or heating and so gives a precise result, and always. Niagara machines using liquid contact means of drying air have given over 20 years of service. The apparatus is simple, parts are accessible, controls are trustworthy.

Most reliable because...the absorbent is continuously reconcentrated automatically. No moisture-sensitive instruments are required to control your conditions... no solids, salts or solutions of solids are used and there are no corrosive or reactive substances.

Most flexible because...you can obtain any condition at will and hold it as long as you wish in either continuous production, testing or storage.

Write for Bulletins 112 and 131 and complete information on your air conditioning problem.

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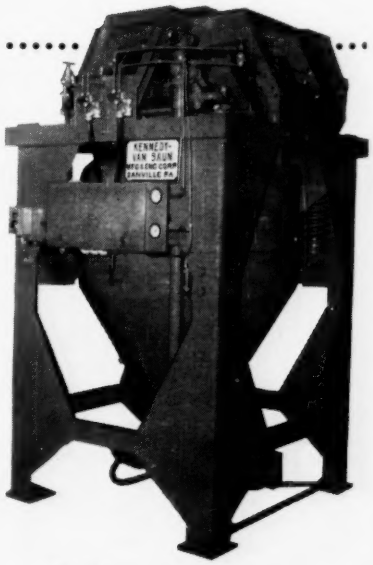
KENNEDY

PNEUMATIC CONVEYING SYSTEMS



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- **No feed screws**
- **No moving parts** while conveying
- **Measures** quantities conveyed, automatically
- **Higher pressures** for higher efficiency —smaller pipelines
- **Air** used only while conveying
- **Adaptable** to full automation
- **Handles several materials** without contamination

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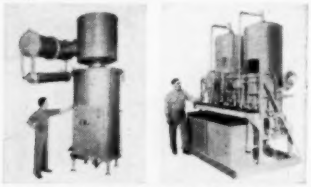
Small roller bearings . . . some as tiny as the period at the end of this sentence are produced by Miniature Precision Bearings, Inc., of Keene, N.H. with an assist from Barnstead Distilled Water.

Even Roller Bearings *ROLL* Better With BARNSTEAD Distilled Water

Barnstead Stills provide a reliable source of *purest water* in either laboratory or production quantities. At Miniature Precision Bearings, Inc., this is what they say: "This water Still is used in our vital laboratory work on the metallurgy of metals in our bearings and tools. A great deal of time is spent in analyzing the causes of bearing failure. . . . Dust for example, is analyzed optically and chemically. . . . Naturally, the purest distilled water is needed for much of this work and Barnstead equipment fills this need nicely."



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T214 All items discussed
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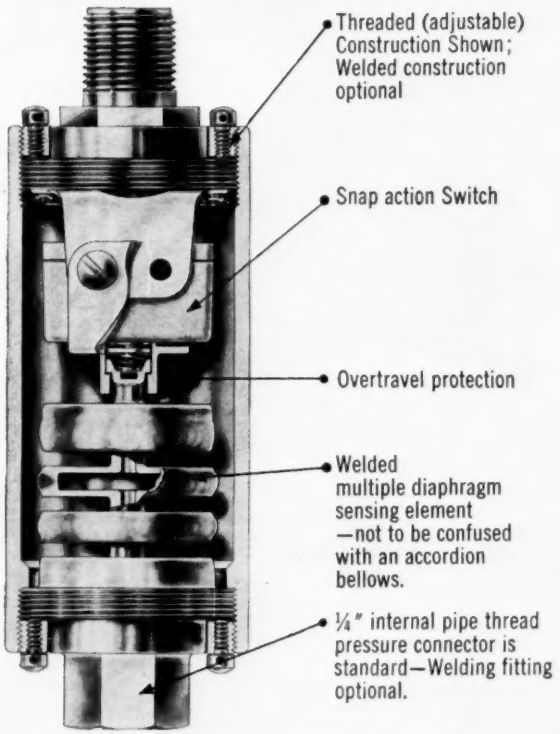
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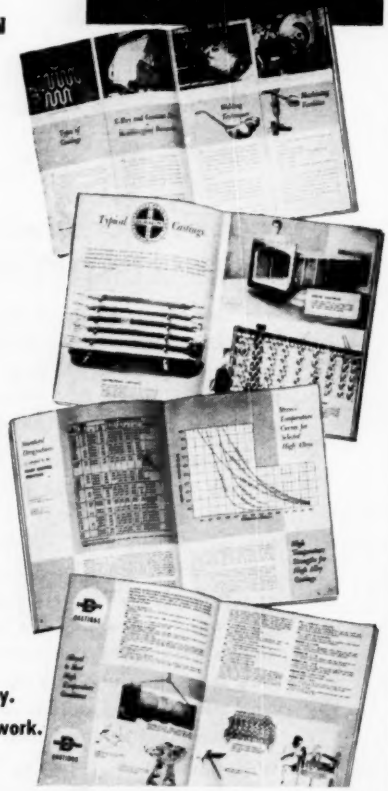

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Aluminum Chemicals.....48 p. booklet summarizes technology of present applications, suggests new uses of aluminum chemicals. Covers calcined, fused, activated bauxite; aluminas; etc.
209A Reynolds Metals Co.

Anti-Skinning Agents ..... National ASA, National Antioxidant B and National Antioxidant D are three anti-skinning agents described in Data Sheet 20758. Agents are used in coatings, inks.
209B National Aniline Div.

Bromine....."Bromine—Its Properties and Uses" contains references to over 500 bromine compounds. "How to Handle Bromine" covers characteristics, methods of shipment, accident prevention, first aid.
209C Michigan Chemical Corp.

Cements, Gypsum....."Your Guide to Superior Results" explains step-by-step methods and procedures for getting best results with USG pottery plasters and gypsum cements. Aimed at ceramic industry.
209D U. S. Gypsum Co.

Chemical Specialties.....1958 catalog includes analytical reports on over 1,500 tradenamed specialties. Reports on cleaners, detergents, cosmetic preparations, waxes, polishes, bleachers, etc.
209E Chemical Specialties Research

Coating, Roof.....Glass fibres in roof coating, Fibre Glass Supercote, prevent movement of the asphalt cover and sagging or pulling away from high spots in temperatures to 140 F. Bulletin A525.
209F Garland Co.

Defoamers.....12 defoamers for the papermaking industry are listed in technical bulletin. Included is information on defoamers' physical properties, suggested uses, methods of use.
209G Hercules Powder Co.

Esters....."Esters by Glyco" includes descriptions of glycerol, glycol, polyethylene glycol esters of higher fatty acids which are made on a tonnage basis at Williamsport, Pa. Covers properties, applications.
209H Glyco Products Co.

Ethers, Methylcellulose.....Methocels, family of methylcellulose ethers, are synthetic water-soluble gums used for thickeners, emulsifiers, emulsion stabilizers, suspending agents, binders.
209I Dow Chemical Co.

Fillers, Rubber.....Bulletin 104-3 covers evaluation of clays as fillers for butyl rubber. Discusses dry processed clays, wet processed clays, calcined clays and their physical properties.
209J Thiokol Chemical Corp.

Fine Chemicals.....162 p. chemical catalog lists over 4,000 fine organics, inorganic reagents, indicators and stains. New items are listed, including line of Spectroquality solvents.
209K Matheson Coleman & Bell

Methacrylonitrile.....Typical properties, reactions of methacrylonitrile and discussion of characteristics of polymethacrylonitrile in variety of end-use applications are set forth in TRD-N-103.
209L Eastman Chemical Products

Methanol.....Brochure on methanol describes its varied applications, physical properties, specifications; information on handling, storage, health hazards and precautions.
209M Reichhold Chemicals.
Send for your free copy.

Plastisols....."Effects of Shear Rates, Temperature and Time on Viscosity of Plastisols" provides relative data on such plasticizers as phthalates, phosphates, adipates, epoxies, polymerics.
209N Firestone Plastics Co.

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• From advertisement, this issue

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Where: Davison Chemical Company
Division of W. R. Grace & Co.

Type Filter: 24" 4-eye c.d. Washing Type

Filtering: Thorium Hydroxide Slurry (Density = 1.2)

Cake Characteristic: Slimy

Average Daily Operating Time: 16 hours

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Average Life of Regular Cotton Cloth: 1 week

This is just one case history out of thousands where a "special" NFM Filter Cloth is outperforming and outlasting other types of cloth.

Over fifty years of weaving experience have given us the "know how" so necessary to the production of top quality Industrial Filtering Fabrics. In addition to many types of cotton cloth, we weave all these synthetic fibers in our own plant: Glass, Nylon, Dacron,†† Saran, Vincel,† Orlon,* Dynel, Teflon,*** Polyethylene and Polymax.†

Write us about your requirements. We'll be glad to send you test samples and to give you the benefit, without obligation, of the knowledge we have accumulated in our many years of servicing the processing field.

* TM for duPont Acrylic Fiber
*** TM for duPont Tetrafluorethylene Fiber
† TM—NFM Reg. U. S. Pat. Off.
†† TM for duPont Polyester Fiber

Weavers of Industrial Filter Media for over Fifty Years

The NATIONAL FILTER MEDIA Corporation

General Offices and Mills: New Haven 14, Conn.
Western Office and Factory: Salt Lake City 10, Utah

Hudson, Ohio: 227 Hartford Drive
Los Angeles, Calif.: 416 West 8th St.
Chicago, Ill.: 6034 N. Cicero Ave.
Elizabethton, Tenn.: Paul Chapman Assoc., Box 787
Toronto: Lee Benner Chem., C. P. R. Roadway, 1119 Yonge Street
Mexico City: Maquinaria Minera, Apartado Postal #215
Cincinnati, Ohio: Roselawn Center Bldg.
Houston, Texas: 1607 Jefferson Ave.
Pensacola, Fla.: Chem-Quip Co., 1102 Texar Drive
Montreal: Lee Benner Chem., 4700 Prince of Wales

LITERATURE . . .

Polyurethanes.....Series of brochures on rigid, semi-rigid and flexible Stafoam polyurethanes include descriptions of usage, processes, formulations, physical properties, engineering data.
210A American Latex Prod. Corp.

Potting Compound.....Helix potting compound P-460 is 100% epoxy resin compound effective from —80 F. to 450 F. Poured cold, cures at room temperature in two hours, good dielectric strength. Catalog 460.
210B Carl H. Biggs Co.

Resins, Polyethylene.....36 p. booklet explains how Tenite polyethylene resins can be used to make wide variety of functional and attractive plastic products, e.g., housewares, toys, packaging, pipe.
210C Eastman Chemical Products.

Silicas.....Typical chemical, physical properties and applications of 11 Syloid micron-size silica products are described in technical booklet. Compounds used for flatting, antiblocking, thickening.
210D Davison Chemical Co.

Solvents.....where odor is a problem use these solvents—Sol 71 & 72 for polishes & cleaners, Sol 360 for faster evaporation than mineral spirits, Sol 140 for highflash. Write for bulletin now.
51 *Shell Oil Co.

Surfactants.....Adducts of nonylphenol or tridecyl alcohol with ethylene oxide are marketed under trademark, Surfonic. Agents are used in preparation of agricultural chemicals, cleaners, etc.
210E Jefferson Chemical Co.

Surfactants, Amphoteric.....Miranol M series of amphoteric surfactants —their chemical stability; foaming, germicidal power; typical end uses, etc.—are described in 32 p. technical bulletin.
210F Miranol Chemical Co.

Titanium.....write today for "Titanium Fact File" for the technical facts. Corrosion resistance, ready availability & high-strength-to-weight are the exclusive properties of titanium.
71 *Mallory-Sharon Metals Corp.

Construction Materials

Alloys, Copper-Silicon . . . . . corrosion resistant alloy can be used for tanks & industrial equipment, in water & waste systems, for electrical conduits & many other applications. Publication E-5.
59 *American Brass Co.

Aluminum Building Materials.....for corrugated roofing & siding, for the lowest cost insulated metal wall system known remember corrosion-proof Alcoa. Full technical data in the new 38-page book.
36 *Alcoa, Aluminum Co. of Amer.

Castings, High Alloy.....16 pages of useful information about chrome-nickel & chrome-iron castings, so necessary when corrosion, high temperatures & abrasion must be resisted. Send for your copy today.
208 *Duraloy Co

* From advertisement, this issue

Cement, Insulating.....Characteristics and specs of Mono-Block and improved Super Powerhouse cement, high-temperature spun mineral wool insulating materials, are described in 8 p. booklet.
211A Baldwin-Hill Co.

Coatings.....sprays seamless, pore-free lining. Outstanding resistance to abrasion, absolutely corrosion resistant. Vinyl material which lends itself to patching & rebaking. Bul. Chem-C-3.
102 *Metal & Thermit Corp.

Coating, Anti-Corrosion.....Niphos process gives any mild steel resistance approaching that of stainless steel. Bulletin defines process from standpoint of its alloy-bond nature, application, etc.
211B Tube Reducing Corp.

Coatings, ceramic.....extremely hard, chemically inert ceramic sprays eliminate "chewed up" or "scored" shafts & sleeves. Ideal protection against shaft wear. Write for new Bulletin CP 28 immediately.
L219 *Chem. & Power Prod. Inc.

Insulations.....high strength—light weight—moisture resistant & low thermal conductivity make for top insulating effectiveness for outdoor process industry applications. Bulletin IN-169A.
16 *Johns-Manville Inc.

Insulation, Mica.....Isomica-Epoxy branch insulation combines Samica reconstituted mica with epoxy resin binders. Material has high electrical properties; used with Class B electrical equipment.
211C Mica Insulator Div.

Insulation, Pipe.....No. 101 pipe insulation is speed-fastening, high-temperature mineral wool material with tie wires already attached. Efficient around pipes with temperatures to 1,200 F.; 4-30 in. dia.
211D Baldwin-Hill Co.

Steel, Stainless Cast.....bolster life of pumps by exercising effective control over corrosion. For high product quality & low pump maintenance write & request the new Inco booklet.
114B *International Nickel Co., Inc.

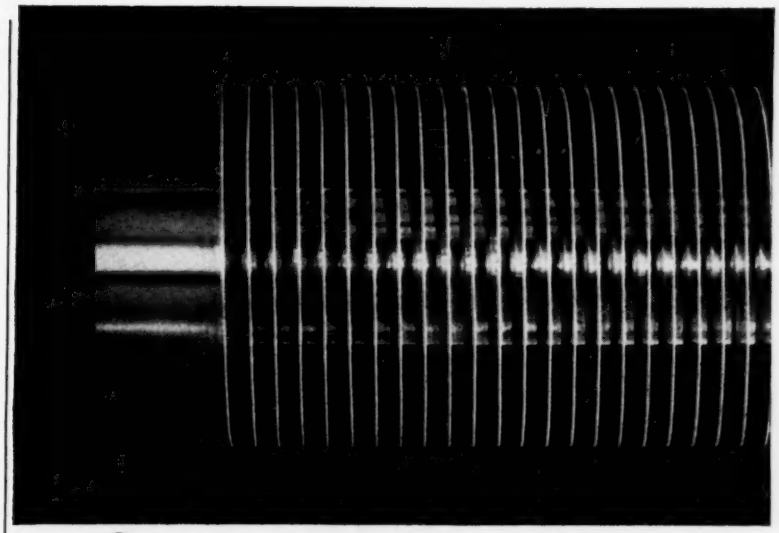
Electrical & Mechanical

Conduit, Liquid-Tight.....How and where liquid-tight flexible wiring conduit, Liquatite, protects wiring circuits from oil chemicals, water, corrosives, dirt, grease, etc. is covered in Sheet LT 110.
211E Electri-Flex Co.

Electrical-Mechanical Equipment..... Brochure BRI describes services of Tele-Tronics Co., designers and/or fabricators of custom-built electrical-electronic and mechanical equipment for various industries.
211F Tele-Tronics Co.

Motors, Corrosion-Proof.....Bulletin 1200 gives complete story on the newest motor to carry Underwriters label. New, rugged frame design. Totally enclosed, improved performance in all hazardous spots.
113 *Fairbanks-Morse & Co.

* From advertisement, this issue



AEROFIN
Smooth-Fin Coils offer you

Greater Heat Transfer per sq. ft. of face area

Lower Airway Resistance —less power per c.f.m.

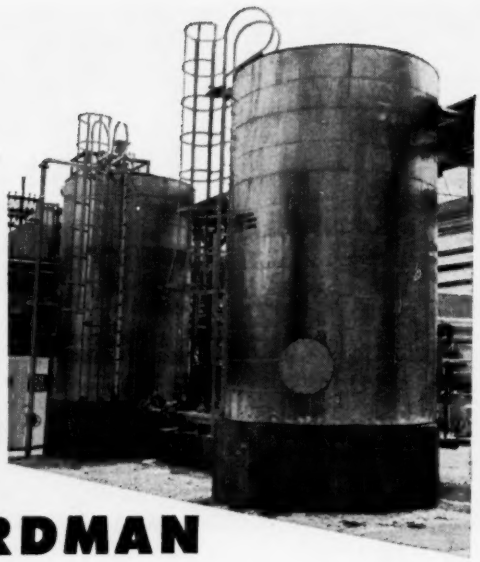
Aerofin smooth fins can be spaced as closely as 14 per inch with low air friction. Consequently, the heat-exchange capacity per square foot of face area is extremely high, and the use of high air velocities entirely practical. Tapered fin construction provides ample tube-contact surface so that the entire fin becomes effective transfer surface. Standardized encased units arranged for simple, quick, economical installation.

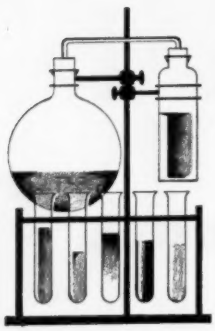
AEROFIN CORPORATION
101 Greenway Ave., Syracuse 3, N. Y.

Write for Bulletin S-55

Aerofin is sold only by manufacturers of fan system apparatus. List on request.

***Rubber— not bubbles— gets a start in these soap and water tanks by* BOARDMAN**





These 10,000-gallon tanks at the Port Neches, Texas plant of the Texas-U. S. Chemical Company contain the emulsifying agents used in manufacturing a superior, general purpose type of synthetic rubber. Each tank is 10′x17′, and after installation, was jacketed with aluminum insulation. The BOARDMAN-built tanks were fabricated to the customer's exact specification.

Standard and custom-engineered metal products manufactured by BOARDMAN are in wide use throughout the chemical process industries. Metals employed include stainless steel, carbon and clad steels, wrought iron and aluminum. No matter how exacting the specifications may be for your metal products requirements, BOARDMAN's 7-acre facilities and 46 years of experience are at your disposal.

Working with metal is a specialty at . . .

BOARDMAN

THE BOARDMAN CO.

OKLAHOMA CITY, OKLAHOMA

Write for the brochure "Working with Metal . . . at Boardman"

LITERATURE . . .

Motor, Induction.....Syncro-Speede synchronous induction motor is said to be first such motor built in same NEMA frame size as standard motor of equal hp. in ratings from 1 to 100 hp. Bulletin 1900.
212A Louis Allis Co.

Rectifiers, Silicon.....Bulletin GEC-1485 describes extra features of high quality, "self-protected", silicon power conversion units designed for general purpose industrial, commercial applications.
212B General Electric Co.

Starters, Motor . . . . . part-winding starter eliminates need for auto-transformers or resistors. Minimum maintenance & ease of installation. Bulletins MU-128 & MU-195 on request.
98 *Wagner Electric Corp.

Strapping Tool.....B5 Stretcher provides faster, easier tensioning of steel strapping. Tool is precision balanced so that strap can be applied with ease from any direction with tool in any position.
212C Acme Steel Co.

Switches, Pressure.....for highly corrosive media. Save the expense of chemical protectors by using this tier-tube line in materials suitable for use with H_2O_2, liquid O_2 & others. Bulletins 1110 & 1170.
207 *Barksdale Valves

Transducers, High Pressure.....Model H pressure transducers provide very accurate measure of pressures in corrosive fluids while exposed to extreme environmental conditions. Bulletin SI-581.
212D Servonic Instruments.

Transducers, pressure.....converts pressure signals to dc signals for use with data handling, telemetering or computer equipment. External power supply for signal-to-noise ratio. Bulletin TP515.
26 *Manning, Maxwell & Moore

Traps, Steam.....Details on complete line of Impulse steam traps is contained in Bulletin T-1742 (57). Typical installatoions for all services are shown with useful dimensions, capacities, weights, prices.
212E Yarnall-Waring Co.

Wires, Thermocouple.....Wire Catalog #32-E will find for you the exact type thermocouple & thermocouple extension wire that you need. Solid & standard conductors available in all standard calibrations.
B215 *Thermo Electric Co. Inc.

Handling & Packaging

Conveyors, Airstream.....space-saving system with pipelines which adapt to existing set-up. 1-man part-time supervision all that's needed. Request new 32-page brochure to solve bulk handling.
99 *Dracco Div. of Fuller Co.

Hoists, Hand . . . . . Wright Safeway hand hoists are available in 17 different lifting capacities from ½ to 50 tons. Bulletin DH-164-C gives data on units' compact design, specs, clearances, dimensions.
212F Wright Hoist Div.

* From advertisement, this issue

Hopper.....Dual-purpose hopper can be used for weighing or storage of fluffy, difficult-to-handle dry materials. Product Data Sheet 5704 covers operating details, capacities, construction features.
213A Richardson Scale Co.

Tanks.....in the booklet "Tank Talks" you will learn of tanks & vessels for chemical storage made in carbon & stainless steel, pressure vessels & processing equipment of aluminum & special alloys.
B214 R. D. Cole Mfg. Co.

Tanks, Process.....write for Bulletins 5-2 & C-1 for complete information on tanks with mild steel or concrete shell, corrosion-proof linings & acid brick sheathings. Far less costly to install.
L221 *Atlas Mineral Products Co.

Heating & Cooling

Coils, Finned.....smooth fin coils offer greater heat transfer per square foot of face area & lower airway resistance. Tapered fin design provides efficient heat transfer surface. Bulletin s-55.
211 *Aerofin Corporation

Condensers, vapor.....reduce operating costs with this air-cooled vapor condenser that gives more capacity at a saving of steam & power. For pure condensates, better recovery of residues send for Bul. 129R.
B229 *Niagara Blower Co.

Condenser Tubes.....Revised manual B-2 discusses application and installation of copper and copper alloy condenser and heat exchanger tubes; also plates for tube sheets, heads and baffles.
213B American Brass Co.

Furnaces, Tempering.....Production tempering furnaces have "straight-through" feature, automatic loading equipment for in-line operation. Bulletin DL-58 includes spec table of units' various dimensions.
213C Ipsen Industries.

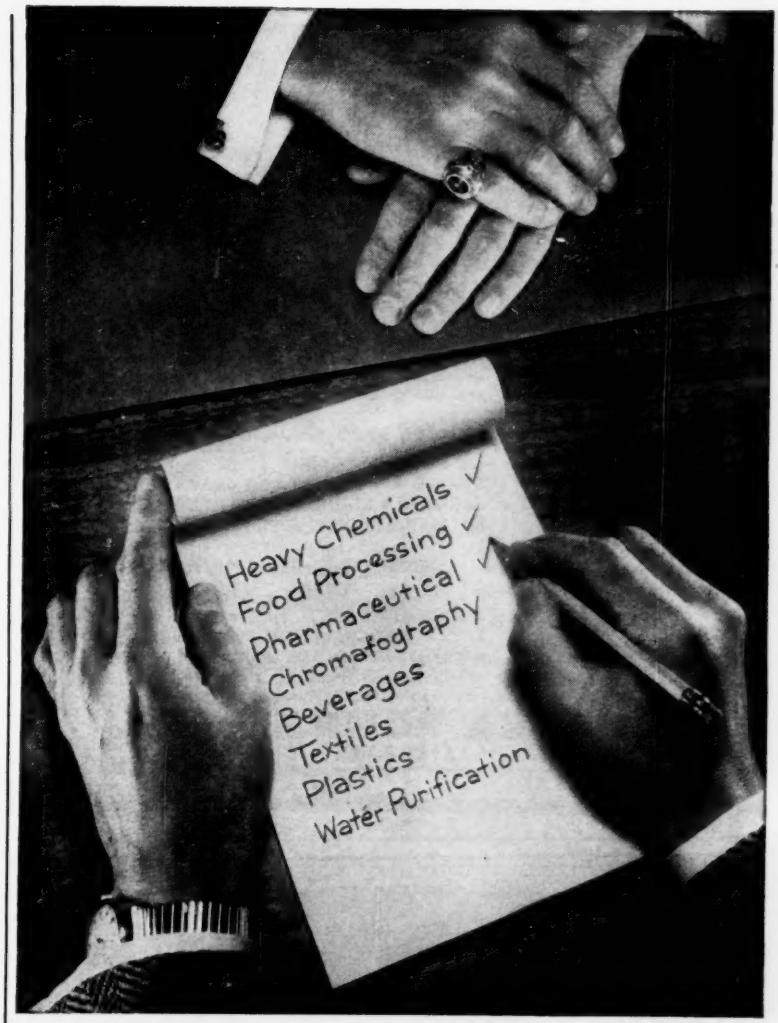
Heaters.....Bulletin 145, "Gradiation Heating for Petroleum & Chemical Processing" gives complete story on more compact, less costly heaters in pyrolysis service. Uniform distribution of radiant heat.
110 *Selas Corp. of America

Heaters, Circulation.....for anything that's piped-water, air, transfer fluids, & steam. Get the full story by writing for Bulletin 701 & new case studies immediately if you want automatic heating.
166 *Chromalox, Wiegland Co.

Heating Elements.....New processes allow fabrication of three-dimensional electric heaters. Units are made of silicone rubber sans expensive tooling; flexible from −90 F. to 450 F. Catalog 103.
213D Electro-Flex Heat.

Kilns, Rotary.....with roller supports to insure easy alignment, continuous operation & low maintenance of our complete line of kilns, coolers, dryers, & shakers. Send for Bulletin #1115.
24 *Traylor Engineering & Mfg. Co.

* From advertisement, this issue



Let us prove SOLKA®-FLOC is your best filter aid!

Let us give you the facts on this versatile filter aid. Whether your field is heavy chemicals, food processing, pharmaceuticals, chromatography, beverages, textiles, plastics, water purification, stream pollution or a long list of others, it can benefit you.

We'll gladly tell you exactly how and why SOLKA-FLOC – economical, finely divided cellulose – performs so efficiently. How it improves your filtration rates ... keeps screens cleaner ... saves down time ... gives you more economical volume of clarified filtrate with minimum retention of filtrate in the cake.

We'll show you why it makes a stable pre-coat, does not bleed, yet prevents loss of cake from pressure drops. And why it does not abrade pumps and valves. SOLKA-FLOC also *adsorbs* many metals such as iron, copper, other impurities.

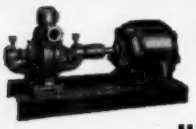
Write us about your specific filtration problems. Address Dept. DF-5, our Boston office.

BROWN COMPANY

General Sales Offices: 150 Causeway Street, Boston 14, Mass. *Mills:* Berlin and Gorham, N.H.
Sold in Canada by Brown Forest Products, Ltd., Montreal, Que. (ALPHA-FLOC)

Superb Performers

AURORA APCO Turbine-Type PUMPS



AURORA Always PUMPS

AURORA® Centrifugal

for EVERY LIQUIDS HANDLING JOB in INDUSTRY

ASK for CONDENSED CATALOG M-55

The engineer-favor accorded "PUMPS by Aurora" rests squarely upon performance satisfaction. Why not let Aurora precision and quality serve your requirements, too?

AURORA APCO *Turbine-Type* PUMPS

are available in SINGLE STAGE • TWO STAGE • FOUR STAGE • WATER JACKETED • STAINLESS STEEL or SPECIAL METALS for "1001" DUTIES.

AURORA *Centrifugal* PUMPS

are available in SINGLE and TWO STAGE HORIZONTALLY SPLIT CASE • SIDE SUCTION • VERTICAL • NON CLOG • SUMP • MIXED FLOW • SPECIAL DESIGN ETC.

AURORA PUMP DIVISION
THE NEW YORK AIR BRAKE COMPANY
43 LOUCKS ST. • AURORA • ILLINOIS
EXPORT DEPARTMENT — Aurora, Illinois — Cable Address "NYABINT"

TANKS for CHEMICAL STORAGE

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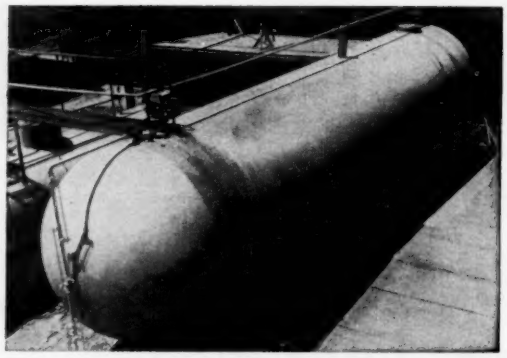
Backed by 103 Years of Fabrication Experience



• We have been supplying the chemical processing industry with tanks and vessels for chemical storage for three generations. In addition to carbon and stainless steel, we also fabricate and erect tanks, pressure vessels and processing equipment of aluminum and special alloys. . . . Investigate our facilities and take advantage of our 103 years of specialized knowledge and experience. . . . Write for *Tank Talks.*

R. D. COLE MANUFACTURING CO. COLE NEWNAN, GEORGIA

Elevated Tanks, Pressure Vessels, Chemical and Processing Equipment from Aluminum, Stainless and Carbon Steel, Monel and Other Alloys.

Established 1854

R. D. COLE MANUFACTURING CO.
NEWNAN, GEORGIA

LITERATURE . . .

Ovens, Laboratory.....Bulletin #107 describes exacting testing & production ovens with close heat uniformity. Capacity loads at high speed. For drying, heating, baking, & testing processes.
L181 *Despatch Oven Co.

Thermo-Panels.....completely eliminates old-fashioned pipe coils to save you money and to provide more efficient heating or cooling for tanks. Read Bulletin 355, & for price data Bulletin 258.
TL229
*Dean Thermo-Panel Coil Div.

Traps, Steam & Strainers.....an impulse Steam trap & a fine screen strainer make a good team for steam. All types of steam equipment available. For the complete story get Your Free Steam Trap Book.
R217 *Yarnall-Waring Co.

Instruments & Controls

Analyzers, Gas.....Request Data Sheet 463-61 today for the complete technical story on magneitc O_2 Analyzer Recorders. Designed for continuous operation, has its own vacuum pump & filters.
34 *Leeds & Northrup

Control systems, Supervisory.....get free information on new remote operation economy regardless of control distance for power distribution, motors, valves, pumps, & industrial water systems. Bulletin.
191 *General Electric

Gauges, high pressure.....thru vision, reflex single or double sections & tubular gauges. Also gauge cocks, large chamber reflex gauges & heated or cooled gauges. Send for complete catalog now.
R219 *Strahman Valves, Inc.

Gage, Magnetic.....for liquid levels. Safety design seals against escaping gases. Magnetically actuated scale thru chamber wall. For pressures to 2,500 lbs. @ 600° F. Write now for Engineering Sheet.
L217 *Jurguson Gage & Valve Co.

Gages, Reflex.....with alloy Steel Bolts for high temperature service, interchangeable gaskets & cushions, extra heavy beam at end of frame to prevent distortion. Request Catalog 36 for full details.
198 *Penberthy Mfg. Co.

Meters.....measure two ingredients in 15 sec. with automatic accuracy with the Neptune batching meter. Only one of the many meters we carry. Request your free Bulletin 567-F now.
178 *Neptune Meter Co.

Microscope, Electron.....Text of 6 p. folder explains electron optical system, filament replacement, lens system and viewing screen, vacuum system, instrument operation of Norelco EM-75B microscope.
214A Philips Electronics.

Pyrometer.....Alnor Pyrotroller is indicating-controlling pyrometer with simplified design. Compact unit requires less than ⅛ sq. ft. of panel space, has reduced initial and maintenance costs.
214B Illinois Testing Laboratories.

* From advertisement, this issue

Pyrometers.....accurate readings of all low surface temperatures. Portable, large 6" mirrored scale for direct reading, no conversion. Comes complete with matched thermocouple & lead. Bulletin 4257.
R220 *Illinois Testing Labs.

Spectrophotometers.....Bulletin 724 describes low-cost infrared spectrophotometers for routine lab analyses. Stresses features of Beckman Double-Beam IR-5 and Single-Beam IR-6 models.
215A Beckman Scientific Instru.

Pipe, Fittings, Valves

Elbows, Welding.....available in any material that can be secured on plate. Stainless steel & stainless-clad types. Special quality controls and quality standards. Write for a complete Catalog (#54) today.
107 *Midwest Piping Co., Inc.

Fittings.....Request your catalog today on stainless steel fittings with gasket seatings to eliminate troublesome ground joints. Bimetallic to permit easy disassembly. Send for Color Catalog.
77 *Horace T. Potts Co.

Fittings, Access.....Cosasco access fittings are simplified devices for gaining access under pressure to interiors of oil wells, pipelines, etc. 32 p. catalog covers complete line of fittings.
215B Cosasco Div.

Fittings, Stainless Steel.....8 p. booklet describes uses and advantages of line of Quikupl stainless fittings. Fittings permit piping engineers to take advantage of economical light wall tubing.
215C Vanton Pump & Equip. Corp.

Fittings, Welding.....with minimum installation time & costs & dimensional accuracy. Ensures trouble-free fabrication. Welding fittings & forged steel flanges available in carbon steel. Bulletin FB504.
120 *Babcock & Wilcox Co.

Joints.....provide safe easy handling of liquid missile fuels. Stainless expansion joints for use in nuclear, missile & industrial applications. Complete range of sizes, tame high pressure problems. Cat.
92 *Solar Aircraft Co.

Joints, Expansion.....request our new 28-page expansion joint design guide for the inside story on the complete line of free-flexing & controlled flexing; pressure-balanced joints & other designs.
182 *Flexonics Corp.

Joints, Expansion, Flexible.....for volatiles & gases, with leak-proof security, inherent static protection. In galvanized steel, stainless & bronze with asbestos lined pressure carrier. Booklet.
L220 *Penn. Flexible Metal Tubing

Pipe, Aluminum.....now a complete steam-traced system can be installed in one pipe eliminating the need for steam jacketing & permits the use of standard insulation. Free brochure on request.
27 *Reynolds Aluminum Co.

* From advertisement, this issue

permanent magnetic force...

A sleeve, raised and lowered within a nonmagnetic tube, attracts or releases an Alnico magnet attached to the mercury (or dry contact) switch. Basically, this is Magnetrol.

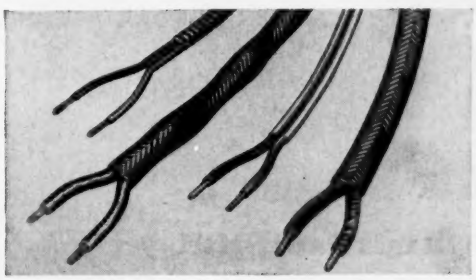
The operating principle behind MAGNETROL LIQUID LEVEL CONTROL

Because its operating principle, based on the proper use of a permanent magnet, guarantees a perpetual guardianship over your critical liquid levels, the Magnetrol liquid level control unobtrusively takes the most important place in any system or process where it is necessary to keep a liquid at a constant level. Principle and action are so simple that failure is virtually impossible. Magnetrol is versatile, too—will handle almost ANY liquid, at ANY temperature, at ANY pressure, with the same precision and dependability. No mechanical or electrical linkages to stick, bind, ride out of line or wear out. Available for controlling level changes from ⅛" to 150 ft. Multi-stage switching when desired. Write to

MAGNETROL, Inc., 2124 S. Marshall Blvd., Chicago 23, Illinois

Thermocouple Wires

Quality • Variety • Delivery



Thermo Electric makes thermocouple and thermocouple extension wires for every possible use—actually over 1500 varieties. Just a few seconds with a T-E Wire Catalog will find the exact type you need. Solid and stranded conductors are available in all standard calibrations. The most modern types of insulations will meet all conditions of moisture, chemical action, abrasion and high temperature. Our own complete facilities for wire drawing, insulating and calibrating guarantee you unmatched quality. Prompt delivery on most types from our large stock.

Write for New Wire Catalog No. 32-E

Thermo Electric Co., Inc.
SADDLE BROOK, NEW JERSEY
In Canada—THERMO ELECTRIC (Canada) Ltd., Brampton, Ont.

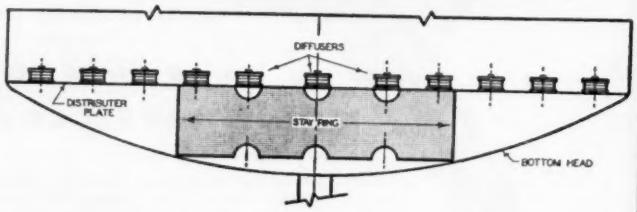
(Two of a series)

IS YOUR *WATER* AS GOOD AS YOUR *ION EXCHANGER* IS CAPABLE OF PRODUCING?

HMM Ion Exchangers utilize a fixed *underdrain** that functions without moving parts or a retaining bed. Higher water quality and operating economies are immediately apparent:

- √ Protect treated water quality
- √ Simplify operation
- √ Decrease rinse water consumption
- √ Decrease regeneration time
- √ Eliminate underbed distortion
- √ Eliminate most bed channeling

*THE HMM UNDERDRAIN FEATURE IS PATENT PENDING



FIELD tested and proved in hundreds of installations, they are suitable for use on any type Ion Exchanger, as well as standard equipment on all HMM Deionizers, Cation Exchangers, Anion Exchangers and Softeners.

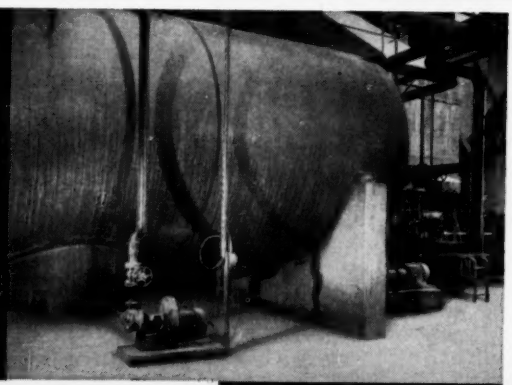
FREE: Write for our Water Treatment "Fact-File-Folder"

H. M. MUELLER CORPORATION

3338 GORHAM AVENUE, MINNEAPOLIS 26, MINNESOTA *Phone: WEst 9-6774*

"Natural water is a *raw* material; it should be *refined* before use."

VIKINGS PUMP THICK SOAP



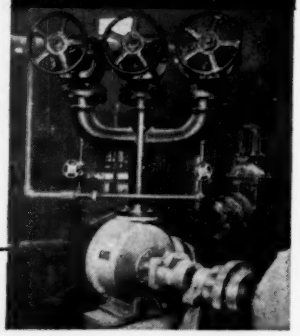
...for St. Regis Paper Mill

In their newly-enlarged Jacksonville, Florida, mill, St. Regis Paper Company installed the most modern, efficient equipment available. Included are three heavy-duty Viking Pumps to handle black liquor soap skimmings. This soap is thick and viscous, yet only two model LQ212 Vikings pump 25,000 gallons a day into two separating tanks. And one model M381 Viking loads 12,000-gallon tank cars in approximately one and a half hours. You see, Vikings are built for rugged pumping.

If you have to move thick liquids, we'd like to help. Write now for bulletin Section CC.

One of the model LQ 212 Viking Pumps connected to soap tanks.

Below, model M 381 Viking Pump, which loads railroad tank cars with soap.



VIKING PUMP COMPANY

Cedar Falls, Iowa, U.S.A. In Canada, it's "ROTO-KING" pumps

See our unit in Chemical Engineering Catalog

LITERATURE . . .

Tubing, Plastic.....Detailed guide includes uses, sizes, dimensions, chemical resistances, working pressures of Cobon (polyvinyl), Cobonol (polyethylene) and Coboflow (Teflon) tubing.
216A Cobon Plastics Corp.

Valves.....For the inside story on pressure evacuators which improve valve operation & performance demand a free Catalog 1900. Safety relief valves insure economy, protection & reliation action.
90 *Manning, Maxwell & Moore

Valves.....full-flow, split-second action valves for use on liquid & gas lines. Latch-type stops flow instantly, must be manually reset. Piston-type opens instantly, ideal for deluge systems. Bulletin 500.
111 *Coppus Engineering Corp.

Valves.....complete line includes gate, globe, & angle type valves faced with hard alloys for greater seat-wear resistance. Resist erosion, corrosion, & galling. Send for Supplement No. L.
147 *Henry Vogt Machine Co.

Valves.....Catalog MV-957, "Fluid Control Products," covers comprehensive line of small valves to fulfill wide-range requirements in instrumentation, design, chemical processing, nucleonics.
216B Hoke.

Valves, Bronze Disc.....tough malleable iron makes up the wheel, high tensile bronze for the spindle, more packing space & easily renewable discs. Descriptive folder #189-B for the full story.
85 *Jenkins Bros.

Valves, Check.....Bulletin 8K covers line of Swing check valves designed for service in steam or water lines to protect against reverse flow. Includes sectional drawings of each valve type.
216C Schutte and Koerting Co.

Valves, diaphragm.....horizontal & vertical types, provide positive check against reverse flow of gas or air. Prevents flow of air into gas lines when air & gas are used together. Bulletin 2000.
216D Norwalk Valve Co.

Valves & Fittings.....alloy construction gives ease of operation & low maintenance, threaded joint eliminates product contact, deep compression box gives tighter seal at stem. Write for Folder today.
113 *Cooper Alloy Corp.

Valves, Solenoid ..... multi-purpose, with new, unique plunger seal design, stainless steel internal construction, brass body & last longer than other valves. Send for Catalog 105 at once.
199 *Valcor Engineering Corp.

Process Equipment

Aspirator.....for the separation by air of mixtures consisting of materials with varying density of air foil. The unit occupies minimum space for fragment control scouring & de-hulling. Bulletin.
216E Entoleter Div.

* From advertisement, this issue

Announcing

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MAGNETIC GAGE

For Liquid Levels

An important advancement in liquid level observation for plants with dangerous explosive or inflammable conditions.

Safety design seals against escaping gases.

Measuring mechanism in stainless steel chamber.

Scale mounted outside chamber; magnetically actuated through chamber wall.

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Patent Applied For

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LITERATURE . . .

Blenders.....for consistently uniform blends . . dust-free, moisture-proof operation . . quick, easy discharge. Lab facilities available. Write for Bulletin 15a-1 for lab info. & Bulletin 15 for production use.
44 *Patterson-Kelley Co.

Centrifugals.....the safest you can buy—because of reverse plowing, overload protection, thermal control built-in, curbing & smooth braking. Write for your copy of Data #2647.
190 *Western States Machine Co.

Cookers, Starch.....for pregelatinized starch manufacture, increases flexibility, improves quality & handles higher solids concentrations. Cuts drying costs for drum products. Bulletin V247.
2 *Girdler Process Equipment

Dryers, Air.....4 p. brochure covers Melsheimer industrial air dryers which are designed to remove water vapor from compressed air to eliminate condensation of water in piping systems.
217A George W. Leseman and Co.

Dryer-Blender.....conical glassed steel, can reduce your operating costs by 50% through elimination of intermediate handling. Thorough drying, homogeneous blending. Data Sheet 26.
232 *Pfaudler Co.

Drying Systems, Flash.....for production of fine dry powdered materials by automatic dust-free operation. Roller, imp & cage mills & air-stream flash drying systems without pulverizing. Bulletins.
122 *Combustion Engineering Inc.

Dust Collector.....bulletin covers cost saving advantages of filter dust collectors. Automatic operation, flexibility of installation, high air-to-cloth ratios, minimum floor loading. Write today.
217B Entoleter Div.

Dust Controls.....consider Ducon cyclones for dry collection. Continuous operation captures nuisance dusts & recovers usuable product. Write today for descriptive Bulletin #DC-49.
189 *Ducon Co.

Equipment, Ion Exchange.....remove mineral impurities from solvent solutions-chemical intermediates-purification of glycerol-with engineered ion-exchange techniques. Write for Bulletin 200.
105 *Industrial Filter & Pump

Exchangers, Ion.....utilize fixed underdrains that function without moving parts or retaining beds. Higher water quality & operating economies. Write for free water treatment "Fact-File Folder".
T216 *H. M. Mueller Corp.

Feeder, Rotary.....S. T. T. type periphery-sealed, eight pocket rotary feeder claims outstanding performance in feeding bulk materials into process lines at differential pressures to 25 psi.
217C Beaumont Birch Co.

Filters, Air.....6 advantages! Easier maintenance, greater CFM, rugged, heavy-duty drive, corrosion-resistant construction, simpler operation & stronger media. Write now for Catalog 248-C.
20 *American Air Filter

* From advertisement, this issue

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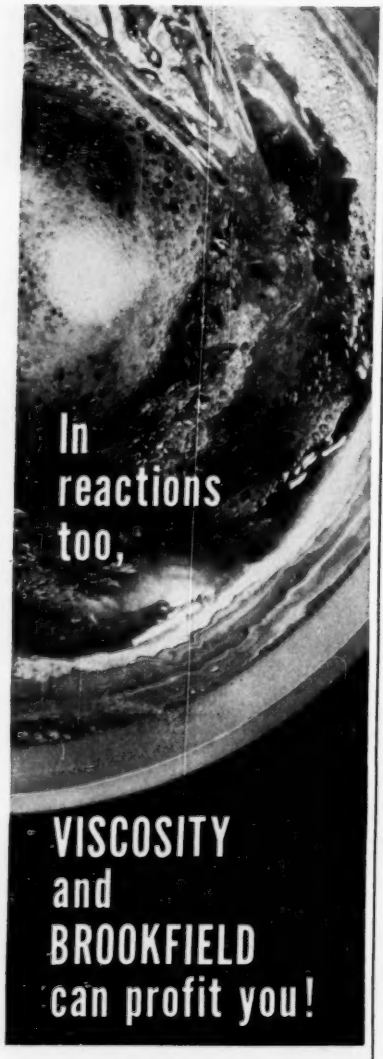

It's true. In-process viscosity measurement is the most direct progress report of many chemical reactions that you can obtain. In polymerization reactions, for example, Brookfield process-mounted Viscometran units eliminate the need for constant sampling, assure greater product uniformity and guard against run-away reactions.

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LITERATURE . . .

Filter, Gas.....removes all fine dust & scale from gas. Composed of removable filter material in treated curled hair or spun glass wool. High capacity at minimum pressure loss at filter. Bulletin 9200.
218A Norwalk Valve Co.

Filters, Water.....Bulletin 651 describes filters in recirculation systems. Bulletin 909 covers filters used for less critical applications. Request these bulletins today for the complete picture.
170 *R. P. Adams Co.

Mills, Dispersion.....Three-roll dispersion mills are available for all types of materials, flowing or paste. Bulletin 158 gives specs and illustrations of construction features on four mill sizes.
218B J. H. Day Co.

Mills, Hammer.....crushes, grinds, shreds to finished size in one operation. Cuts production costs up to 50%. More uniform product, increased output. Explain your operation-and ask for a catalog.
91 *Williams Patent Crusher & Co.

Mills, Impact.....new bulletin tells most efficient method of achieving particle size reduction by centrifugal force. Low h. p. requirements with high put-thru capacities. Bulletin. Write today.
218C *Entoleter Div.

Mixers, centrifugal.....new principle of high speed mixing with increased put-thru. Homogeneous mix, texture improved & color intensified. Adaptable to continuous or batch system. Catalog.
218D Entoleter Div.

Plastic equipment.....versatile plastic can be used for gaskets, sheet linings for tanks & ducts, flexible tubing and paints. Corrosion resistant. For full data send for the free Tygon Portfolio.
42 *U. S. Stoneware

Plastic & Rubber Processing Equipment.....stop contamination with the best, most economical pipes, pumps, valves & tanks in rubber & plastic materials. Many bulletins offered.
194-5a-h
*American Hard Rubber, Ace Div.

Processing Equipment.....solve difficult liquid processing problems with a processor that utilizes turbulent thin-film technique, for heat & mass transfer in one pass, continuously. Catalog 117.
69 *Rodney Hunt Machine Co.

Processing Equipment.....simpler, more compact way to cool, heat or dry in continuous flow. 2 or more flights of hollow-bladed screw conveyors. Product rotates constantly. 8-page bulletin on request.
84 *Western Precipitation Corp.

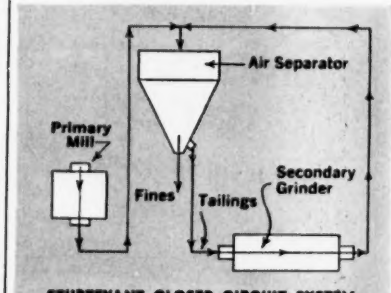
Processing Equipment.....dust filters, separators, & controllers, fans, conveying systems & storage tanks are our business. For the latest in processing equipment write to DAY today. Bulletin 574.
149 *Day Co.

Processing Equipment.....new 12-page booklet, "An Open Door" shows how you can solve processing problems. Expert lifetime engineering service for processing equipment, including spray drying set-ups.
57 *Swenson Evaporator Co.

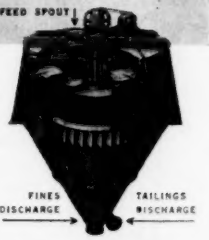
* From advertisement, this issue

STOP OVERWORKING GRINDING MILLS

Boost Production of 40 to 400 Mesh Fines As Much As 300%



STURTEVANT CLOSED CIRCUIT SYSTEM: Primary Mill runs open, load is circulated through air separator. Desired fines are discharged. Oversize recirculates to secondary grinder and then to air separator for further classification.



Current users of Sturtevant Air Separators include manufacturers of sulfur, soybeans, phosphate, chocolate, feldspar, sand, pigments, limestone fillers, abrasives, plasters, ceramics and cement.

Sturtevant Air Separators Can Lower Power Costs Up To 50%

Production capacity impossible in single-pass grinding results from using Sturtevant Air Separators in closed-circuit grinding systems. They are of proved advantage in all secondary reduction processes.

Fines pass through grinding mills unhindered, are classified, and the oversize returns for further grinding. Grinding mills are free to perform at top efficiency, their output frequently increased as much as 300% and power costs cut up to 50% (documented by 30 years of Sturtevant air separation experience in the cement industry).

Precise Classification; Circulates Loads of 800 tph

Sturtevant Air Separators circulate production loads of up to 800 tph. Simple adjustments make possible counter-action between air currents and centrifugal force to the point where a product of almost any desired fineness may be collected while coarser sizes are rejected.

A 16 FT. STURTEVANT, for example, took a feed rate of 800 tph, containing only a small percentage of desired fines, and delivered 30 tph 90% 200 mesh, recirculating the oversize through the grinding circuit. (In the cement industry, Sturtevant units deliver up to 60 tph raw cement fines, 40 tph finished cement fines.)

Nine models available, diameters from 3 to 18 ft. For more information, request Bulletin No. 087. (Bulletins also available on Micronizers, Blenders, Crushers, Grinders.) Write STURTEVANT MILL CO., 100 Clayton St., Boston, Mass.

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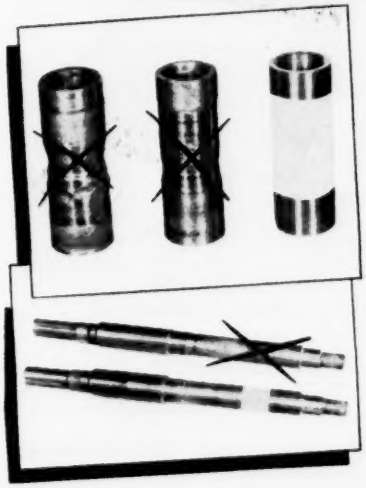

Chempro's new extremely hard, chemically inert ceramic coatings applied to shafts and shaft sleeves eliminate the costly failure of "chewed up" or "scored" shafts and sleeves. Sprayed ceramic surfaces are highly resistant to abrasion, erosion and fretting corrosion under even the most difficult slurry service. They also give ideal protection against shaft wear under high packing gland pressures.

Pump down-time due to shaft or sleeve failure has been drastically reduced in every installation in which Chempro's sprayed ceramic surfacing has been used.

Write for new Chempro Bulletin CP28 for ordering information.

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LITERATURE . . .

Pulverizer & Classifier.....for grinding & classifying in one operation. Air attrition impact with controlled radial inward classification. Request free color bulletin immediately.
75 *Strong-Scott Mfg.

Sifter.....high speed, centrifugal sifting yields perfect dispersion of ingredients. Uniformity of color to colored products. Clean, complete separation. For better quality sifting, get Bulletin #65.
209 *Abbe Engineering Co.

Stills & Demineralizers, Water..... new literature on electrically-heated, gas-heated & steam-heated models. Write for Catalog "G" on stills. Catalog 127-A gives complete details on demineralizers.
T228 *Barnstead Still & Demineralizer

Washer, Hot Gas.....Lehigh Dynamic hot gas washer eliminates most air pollution problems; resists temperatures up to 2,000 F.; incorporates five hot gas collection methods in one unit. Bulletin L-2.
219A Lehigh Fan & Blower Div.

Wire Cloth.....free 94-page catalog describes fabrication facilities & gives useful metallurgical data. Industrial wire cloth & screens come in bulk or fabricated parts. Request it today.
184 *Cambridge Wire Cloth Co.

Pumps, Blowers, Compressors

Air Conditioning Systems.....dry & clean air at the right temperature to control your product quality, to protect against moisture damage, & to assure precision in testing. Bulletins 112 & 131.
TL201 *Niagara Blower Co.

Compression Systems.....Pre-engineered central compression systems supply air or gases at 3,500 to 12,000 psi. at point of use for industrial processing, design, testing. Bulletin 100.
219B Cardox Corp.

Compressors.....capacity of 15 lbs./sec. & operating discharge pressure of 320 psi. Provide maximum power on less fuel in minimum space. Request new Composite Catalog immediately.
103 *Clark Bros. Co.

Compressors, centrifugal.....handles hydrogen at high pressures. But whether you need to handle light or heavy gases at hi or low pressures. it pays to have a look at these barrel types. Bulletin 0504.
87 *De Laval Steam Turbine Co.

Compressors, non-lubricated.....write today for free bulletin describing equipment for producing oil-free compressed air. Compact units, run continuously, no downtime. Bulletin 130-11.
7 *Joy Mfg. Co.

Fans.....Type CE axial flow extension shaft fans are designed for exhausting contaminated fumes from hoods, tanks; spray booth exhaust; oven recirculation. Fans are non-overloading. Bulletin 640-A.
219C Propellair Div.

* From advertisement, this issue

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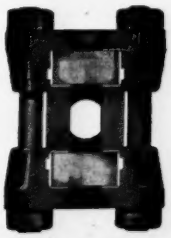

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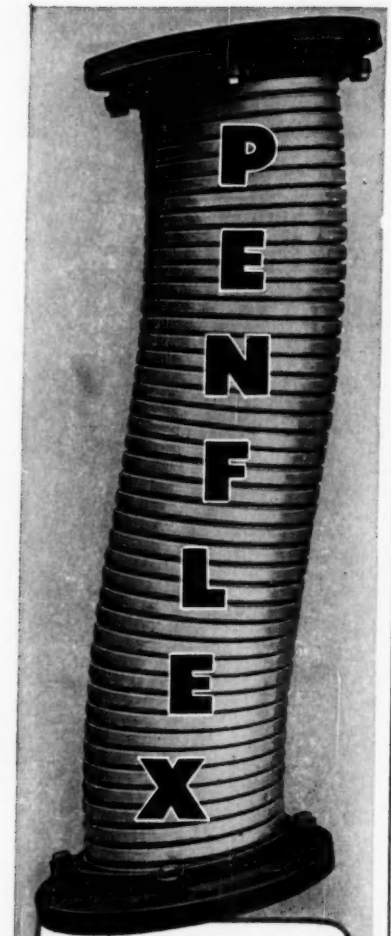

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LITERATURE . . .

Pumps.....Bulletin 725.6 describes self-priming centripetal pump for liquid, air, & liquid & air. Compact, portable & versatile. All-iron construction or in stainless steel for corrosive service.
108 *Goulds Pumps, Inc.

Pumps.....send today for Bulletin V-837 describing complete line of vertical pumps for handling chemicals. Bulletin C-355 has horizontal pumps as its subject. Check these for the pump you need.
174 *Taber Pump Co.

Pumps.....for rugged duty including pumping thick soap skimmings. Can load 12,000-gallon tank cars in 1½ hrs. If you have to move thick liquids, write to day for Bulletin Section C.
B216 *Viking Pump Co.

Pumps.....pump "problem" chemicals that ruin other makes, whether thin watery slurry or heavy viscous material like rubber dough. Few or no repairs needed..show little wear. Bulletin 30-CE.
25 Robbins & Myers, Inc.

Pumps, Centrifugal....."Data Required" guide for specifying corrosion-resistant centrifugal pumps tabulates data essential for successful solution of pump problems; defines misunderstood terms used in industry.
220A Ampco Metal.

Pumps, Centrifugal stainless steel shaft, heavy-duty ball bearings, hydraulically balanced bronze propeller, mechanical seal for long life without attention. Write now for Bulletin 2-2e.
197 *Gardner-Denver Co.

Pumps, Steam-Piston.....For boiler feed or other fluid pumping operations, duplex steam-driven, piston-packed pumps deliver variable volume as needed at constant pressure. Bulletin 202-4.
220B American-Marsh Pumps.

Pumps, Turbine-type & Centrifugal.....Turbine-type available in single stage, two stage, four stage & water jacketed. Centrifugal style in single & two stage horizontally split case. Catalog M-55.
T214 a-b *Aurora Pump Div.

Pumps, Wet Vacuum.....Bulletin 221-4 describes Simplex wet vacuum pumps for vacuum heating systems and manufacturing processes requiring vacuums to 26 in. Lists choices of construction materials.
220C American-Marsh Pumps.

Pump-Meter.....McCannameter's new design affords space savings of up to ⅔ over previous designs. Unit is meter that pumps; packless, positive displacement pump with new pumping principle.
220D Hills-McCanna Co.

Separators, Air.....lower power costs up to 50% by using air separators in closed-circuit grinding systems. Precise classification, circulates loads of 800tph. For more information request Bulletin #087.
R218 *Sturtevant Mill Co.

Ventilators, Roof.....Type L-CRF Airfoil centrifugal power roof ventilators feature backward curved Airfoil design blade that permits moving more air with less noise in both exhaust, supply uses.
220E Ilg Electric Ventilating Co.

* From advertisement, this issue

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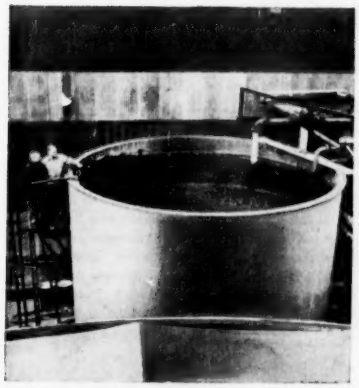


. . . compared to expensive alloys!

Atlas offers you economical process tank construction that will give you longer trouble-free life. This is accomplished by the use of a mild steel or concrete shell protected by corrosion-proof linings and acid brick sheathing jointed with corrosion-proof cements. These Atlas tanks are impervious to today's stronger chemical solutions and higher operating temperatures.

All metals have a real solution rate that may contribute to contamination of the product but Atlas tanks offer complete protection against this possibility. In addition, Atlas construction is far less costly to install than expensive alloys and the tanks are corrosion-proof inside and out.

Write for Atlas Bulletins 5-2 and C-1.

ATLAS MINERAL PRODUCTS COMPANY
MERTZTOWN, PENNSYLVANIA

LITERATURE . . .

Services, Processes, Misc.

Chemical Services.....8 p. brochure describes Gane's Chemical Works facilities for custom work, manufacture of product specialties and pure research. Reviews company's work, lists its line of products.
221A Gane's Chemical Works.

Corrugated Box Service....."Matthews National Advertisers Program," a service for all corrugated box users, simplifies box printing program, puts uniformity in the program, saves time and money.
221B Jas. H. Matthews & Co.

Cost Control....."Controlling Costs" Bulletin G205RR tells how to save money in off-the-ground maintenance; shows what scaffold, ladder equipment to use for typical jobs; expains what to use and where.
221C Patent Scaffolding Co.

Data Systems.....4 pl brochure briefly describes Norden-Ketay's data systems department, typical fields of interest, departmental facilities and types of projects engaged in.
221D Norden-Ketay Corp.

Degreasing, Vapor....."Vapor Degreasing Using Diamond Perchlorethylene" covers major advantages provided by vapor degreasing in production cleaning and metal surface preparation for electroplating, etc.
221E Diamond Alkali Co.

Feed Control.....Electronic feed control keeps flow of solids or liquids into all kinds of motor-driven processing machines at constant, stable maximum capacity; stops jamming due to overloading.
221F Load Star Corp.

Fire Controls.....24-hour-a-day fire protection with a built-in fully-automatic Carbon Dioxide Fire Extinguishing System. Request the Engineered Fire Equipment Booklet today.
188 *Walter Kidde & Co.

Mixing, Paint.....Reprinted article tells how Paragon Co. cuts pigment mixing time by 30%. Savings, operating principles, use of homomixer are explained. Old, new mixing methods contrasted.
221G Gifford-Wood Co.

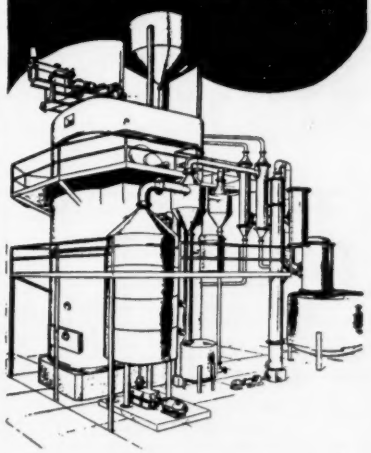
Nuclear Engineering.....Four pamphlets on nuclear engineering are: "Reactor Hazards Analysis," "Vessel Design for Explosive Mixtures," "Nuclear Safety," "Fragment Effects on Structural Elements."
221H Holmes & Narver.

Panel Parts.....Line of volume-produced standard panel parts can be bolted together to make low-cost cubicles in variety of sizes and configurations. Parts can be stocked in customer's storeroom.
221I Falls Metal Works.

Starch Cooking.....Data Sheet F-57-2 describes Corn Products Sales Co.'s system for continuous and automatic starch cooking. Milton Roy controlled volume pumps save tanks, space and costs.
221J Milton Roy Co.

* From advertisement, this issue

FRENCH



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(Continued on opposite page)

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EQUIPMENT SEARCHLIGHT

CE's Searchlight spots the big bargains in used, resale and rental equipment. Check this issue's listings—most complete in the field—for items you need now.

▶ **Coverage**—National (see index of advertisers in this section for your nearest dealer). Equipment and facilities—used, resale and rental — for the process industries. For sale, wanted, for rent.
▶ **Rates**—$21.75 per inch for all ads except on a contract basis; contract rates on request. An advertising inch is measured ⅞ in. vertically on a column; 3 columns, 30 in. per page. Ads acceptable only in display style.
▶ **Closing date**—June 2nd issue closes May 9th. Send all new ads to Chemical Engineering, Classified Adv. Division, P. O. Box 12, New York 36, N. Y.

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5'x30' Buflovak Rotary Vac. Dryer
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8'6"x50' Allis Chalmers Kiln
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14"x30" Day 3-roll High Speed Mill
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40" Fletcher Steel Susp. Cent.
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24" Filter Press 36 NEW Wood P.F.
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1—Niagara Style H Filter, 21 S.S. lvs, 190 sq ft
1—AT&M 42' susp perf. basket Centrifuge
4—Sharples C-27 Super-Dehydr. 316 S.S. 50 HP
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1—Gayco 10' Separator, with 30 HP motor
1—Williams 4 Roll High Side Mill. Spinner
1—Raymond 3 Roller High Side Cone Separator
1—Readco 25 gal double sigma jcktd Mixer
2—Ribbon Blenders, 1 ton cap. motor drive
4—Fitzpatrick Model D Comminuting machines
1—Fitzpatrick Model J Homoloid Mill S.S.
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3—Stokes BB-2 Rotary Tablet Presses
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Filters: Eimco, Oliver, Sweetland, Alsop, Sparkler, Industrial, Sweetland.
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Dopp 150 gal. dbl. act. agitator.
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Jeffery 30 x 24" type A.
Fitz Comminuting model D, st. st.
Mixers: Dbl. and Sgl. arm sigma blade.
Dry Powder, various sizes.
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Percolator: Pfaudler 54 x 42" st. st., jack.
Pumps: Rotary, gear, centrif., vacuum.
Tanks: Stainless steel, various sizes.
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2—Bird 24" x 38", 18" x 28", 304 S.S. solid bowl, continuous.
1—Bird 24" x 38" Monel, solid bowl, continuous.
1—Sharples C20 Super-D-Hydrator, 316 S.S. vapor-tight XP Timers.
2—Sharples PY-14 & PN-14 Super-D-Canters, 304 S.S.
2—Bird 40" suspended, 347 S.S.
1—Bird 40" suspended, rubber.
3—Tolhurst 40", 32", 26", suspended, steel.
1—AT&M 36" centerslung, rubber covered.
1—Fletcher 30" suspended, 304 S.S.

FILTERS

2—Feinc 5' x 6', 304 S.S. Rotary Vac.
1—Sparkler 14D4, 3.2 sq. ft., 304 S.S. with Pump.
5—Sparkler 33-S-28, 150 sq. ft., 304 S.S.
1—Oliver 5'3" x 8' Steel Rotary Vac.
2—Sweetland #12, 48 and 32 leaves.
2—Sweetland #10, 27 bottom drainage leaves.
1—Sweetland #7, 20 S.S. covered leaves.
3—Shriver 30" P&F, 36 chambers, iron.
1—Shriver, 30" P&F, 40 Chambers.
6—Ilico Deionizers 3000 & 1500 gph.

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1—Baker Perkins #15VUMM, 100 gal. jacketed, 100 HP.
1—Baker Perkins #16TRM, 150 gal. jacketed, sigma blades, Vacuum.
1—Baker Perkins 50 gal. jacketed, sigma blades.
5—Day "Cincinnatus" double arm 250 and 100 gals.
5—Steel Powder 50, 225 and 350 cu. ft.
1—10 cu. ft. "V" Blender, 304 S.S.
1—Eppenbach 1 HP, 304 S.S. Homo Mixer.

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3—3500 gal. 347 S.S. Reactors, 150# internal, 55# Jacket.
2—Pfaudler 1500 gal. glass lined, jacketed, agitated Kettles, 90# jacket, 50# internal.
2—Pfaudler 1500 gal. glass lined, jacketed Kettles, 90# jacket, 50# internal.
1—Nooter 1000 gal. nickel-clad, jacketed, agitated Reactor.
2—Patterson 1000 gal. steel jacketed, agitated Dissolvers, 20 HP XP motors.
3—Pfaudler 500 and 300 gal. glass lined, jacketed Reactors.
3—500 gal. 304 S.S., jacketed, agitated Reactors, with heating elements.
1—Blaw-Knox 500 gal. 304 S.S. clad, jacketed, agitated Reactor.
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1—9500 gal. 316 S.S. Horizontal Storage Tank.
1—Haveg 4000 gal. Storage Tank.
4—1000 gal. S.S. clad, Vertical Tanks.

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2—Vulcan 8' x 50' Rotary Kilns.
3—Link Belt Roto Louvre 5'2" x 20', 6'4" x 24', 7'3" x 25'.
4—Devine double door Vacuum, 17 and 20—59" x 78" shelves.
1—Devine single door Vacuum, 20—40" x 43" shelves.
8—Stokes single door Vacuum, 4 and 6—24" x 36" shelves.
3—Louisville Steam Tube 6' x 50', 6' x 40', 6' x 25'.
1—Buflovak 5' x 12' Atmos. single drum.
1—Devine 4' x 9' Atmos. single drum.
1—Buflovak 32" x 72" Monel Twin Drum.
1—P&S Tray Dryer, Steam Heated, 166 sq. ft.

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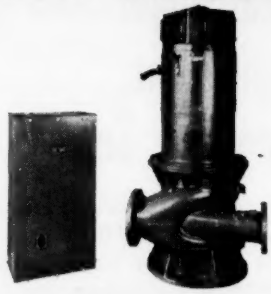
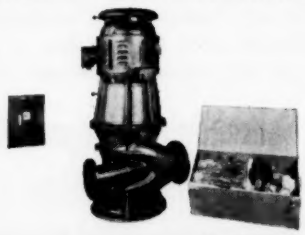
NEW PUMPS



NEW LST BALLAST PUMPS

Vertical — all bronze. Gardner-Denver pump; 8" suction, 6" discharge; 1500 GPM; 56' head. Powered by 30 HP type DN Century motors; 230 volts DC. Frame 375-S. Full magnetic Cutler-Hammer controller, Bulletin 6942. Drip-proof, with push-button control, overload and low voltage protection. In original crates. Excellent for aux. circulating, ballast, booster, etc.



NEW LSM VERTICAL BALLAST PUMPS

All bronze centrifugal pump; 1500 GPM @ 56' head; 30 HP—1750 RPM. Flanged inlet 8"; flanged outlet 6". Powered by Westinghouse 30 HP 440/3/60 1750 RPM motor, marine-type drip-proof, complete with magnetic controller. Use for ballast or circulating.

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4—**LOUISVILLE** 6' x 30' ROTARY STEAM-TUBE DRYERS
5—**ALLIS-CHALMERS** 5'6" x 22' BALL-TUBE MILLS
1—**UNUSED** 20,000 GAL. HORIZ. ST. ST. TANK
2—**UNUSED** 5,000 GAL. HORIZ. ST. ST. TANKS
1—**HERCULES** 125 SQ. FT. ST. ST. LEAF FILTER
1—**TOLHURST** 26" ST. ST. SUSP. BASKET CENTRIF.

1—Complete Marco "Flowmaster" set w/reactor, proportioner, mixer, pumps, etc., st. st.
6—Pfaudler 500 gal. G/L reactors
1—Simpson #1-H intensive mixer, 4' dia pan, SS, 1954 unit
4—Buflovak 42" v 120" Dbl. drum dryers, ASME
2—Nickel evaporators, 400 & 250 sq. ft.
3—1070 sq. ft. ASME 150# SS exchangers
1—36" x 89" VACUUM Dbl. Drum Dryer
1—9' x 30' SS lined rot.
1—Raymond 66" 6-roll LOW SIDE mill, 200 HP
6—465 gal. SS reactors, 175# W.P., 165# jkt.
1—Buflovak 5' x 12' VACUUM Single Drum Dryer, UNUSED
3—Sweetland filters: #12, 7, 5
2—T316 SS Vac. shelf dryers, 108 sq. ft.
4—Davenport dewatering presses: #1A, 2A, 3A
1—Baker-Perkins #15 USE, 100 gal., SS, vac. cover.

PERRY EQUIPMENT CORP.
1413-21 N. Sixth Street, Philadelphia 22, Pa.
Phone POplar 3-3505

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1—Fletcher 30" S.S. Sus. Centrifuge, M.D.
1—Fletcher 48" Centrifugal, S.S. basket.
1—Stokes S.S. 43B Granulator, M.D.
2—Sharples S.S. C-20 & C-27 Super-D-Hydrators.
1—Copper Nickel Heat Exchanger 1483 sq. ft.
2—Devine #28 Vac. Shelf Dryers - 20 shelves Double Door.
2—Stokes "DD2" Rotary Tablet Machines - 23 head.
6—S.S. Vac. & Pressure Tanks 30 to 100 gals.
1—6' dia. S.S. Bubble Cap Column.

SEND FOR BULLETIN A-41 FOR COMPLETE LISTINGS.

The Machinery & Equipment Corp.
293 Frelinghuysen Ave., Newark 12, N. J.
TAlbot 4-2050

MAY SPECIALS

Devine #25 Vac. Dryer, 13 shelves, 59"x70"
Sweetland #5 SS Filter, 20" leaves, on 3" centers
AT&M 48" SS Centrifuge, 30 HP Exp. Pf. motor
Pfaudler Glass Kettles, SS agitator, 3 HP exp. mtrs
Nash Hytor Vac. Pump #6, with 40 H.P. motor
Gen. American 42"x120" Twin Drum Dryer
3—20,000 gal. steel Tanks, welded, dished heads

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1—Downington Iron Works Steel Pressure Tank, 5000 gallons, 200 PSI
2—Robinson Stainless Steel Horizontal Ribbon Blender, 210 cu. ft. capacity
1—Davis Engineering Type 316 Stainless Steel Bubble Cap Column, 8"x20', with 30 plates

CENTRIFUGES:

1—Tolhurst Stainless Steel 32" Suspended Type Centrifuge, with perforate basket, complete with motor and plow.
1—AT&M 42" Suspended Type Centrifuge, complete with type 347 Stainless Steel Perforate Basket, plow and curb, with 40/20 HP Motor
1—Tolhurst 32" Suspended Type Centrifuge with Imperforate Basket

DRYERS:

1—Link Belt Steel Roto Louvre Dryer, Model 604-20, Complete
1—Link Belt Steel Roto Louvre Dryer, Model 310-20
1—Stokes Stainless Steel Rotary Vacuum Dryer, 3' x 15'
1—Traylor Rotary Dryer, 4' x 30'
1—Buflovak Double Drum Dryer, 42" x 120"
1—Stokes Model 59 DS, Steel Rotary Vacuum Dryer, 5' x 30'
2—Louisville Rotary Steam Tube Dryers, 6' x 50', Complete
1—Bartlett & Snow Rotary Dryer, 4'6" x 36'6"
6—Stokes Vacuum Shelf Dryers, 2, 4, 6 and 18 shelves
1—Stokes Double Drum Dryer, 5' x 12'
1—Louisville Rotary Steam Tube Dryer, 8' x 45'

FILTERS:

1—Oliver Horizontal Filter, 6'6"
1—Niagara Stainless Steel Filter, Model 510-28
1—Feinc Stainless Steel Rotary String Filter, 3' x 3'
1—Sperry C.I. Filter Press, 24" x 24", 30 chambers. (New)
1—Oliver Horizontal 3' Pilot Plant Filter, New
1—Sweetland #3 Stainless Steel Filter, 70 sq. ft. filtering area
1—Sweetland #7 Filter with 20 steel leaves

AUTOCLAVES, KETTLES & TANKS:

5—Pfaudler Series R Jacketed Kettles, 1000 gallons
1—Combustion Engineers Steel Jacketed Autoclave, 1600 gallons with agitator and drive, 150# jacket, 600# internal
20—Pfaudler 1000 gallon Vacuum Receivers
1—Glascote Glass-lined Jacketed Kettle, 500 gal.
1—Nickel 1000 gallon jacketed Kettle
1—Lee Jacketed Stainless Steel Kettle, 125 gallons.

MIXERS:

1—Entoleter Stainless Steel Continuous Mixer, Type PF
1—Abbe Lennart Jacketed Mixer, 125 gallons
1—Baker Perkins Stainless Steel Double Arm Jacketed Mixer, with compression cover, 2¼ gallons

THE GELB GIRL—MAY 1958

1—Baker Perkins Stainless Steel Double Arm Jacketed Sigma Blade Mixer, 9 gallons
1—Patterson Steel Jacketed Double Arm Vacuum Mixer, 100 gallons
1—Leader Stainless Steel Jacketed Horizontal Ribbon Blender, 40 cu. ft.
1—Patterson Stainless Steel Jacketed Double Arm Sigma Blade Mixer, 50 gal.
1—Patterson Monel Conical Blender, 4.7 cu. ft.
2—Baker Perkins Double Arm Sigma Blade Jacketed Mixers, 100 gallons.
1—Gedge Gray Stainless Steel Ribbon Blender, 65 cu. ft.
1—Banbury Midget Pilot Plant Mixer
3—Robinson Type 316 Stainless Steel Sigma Type Jacketed Heavy Duty Mixers, 400 gallon capacity, 60 HP
1—Process Engineers Stainless Steel Jacketed Ribbon Blender, 30 cu. ft.

MISCELLANEOUS:

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4—Type 317 Stainless Steel Heat Exchangers, 892 sq. ft. ea., 200 PSI
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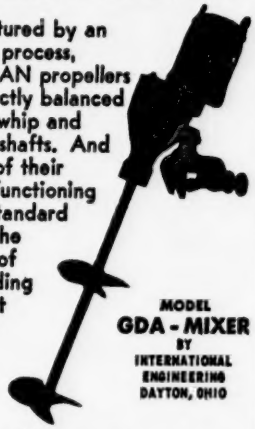

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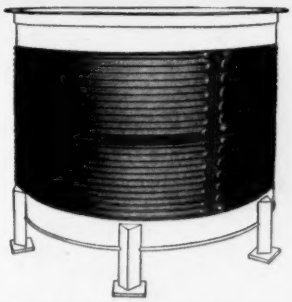

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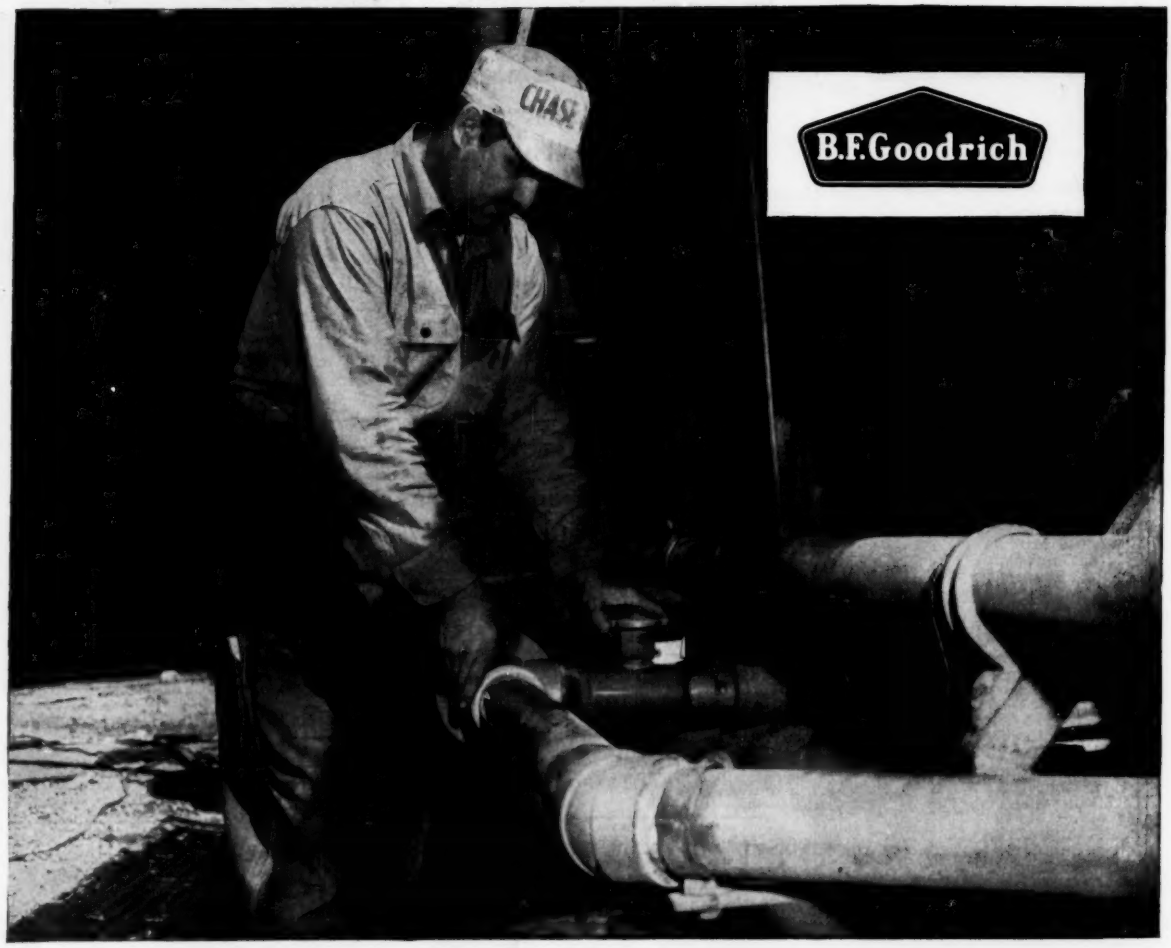

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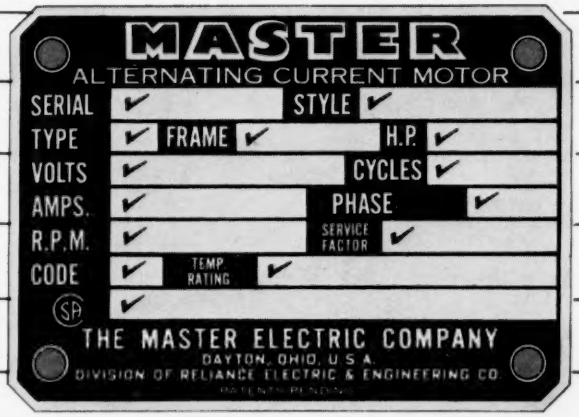

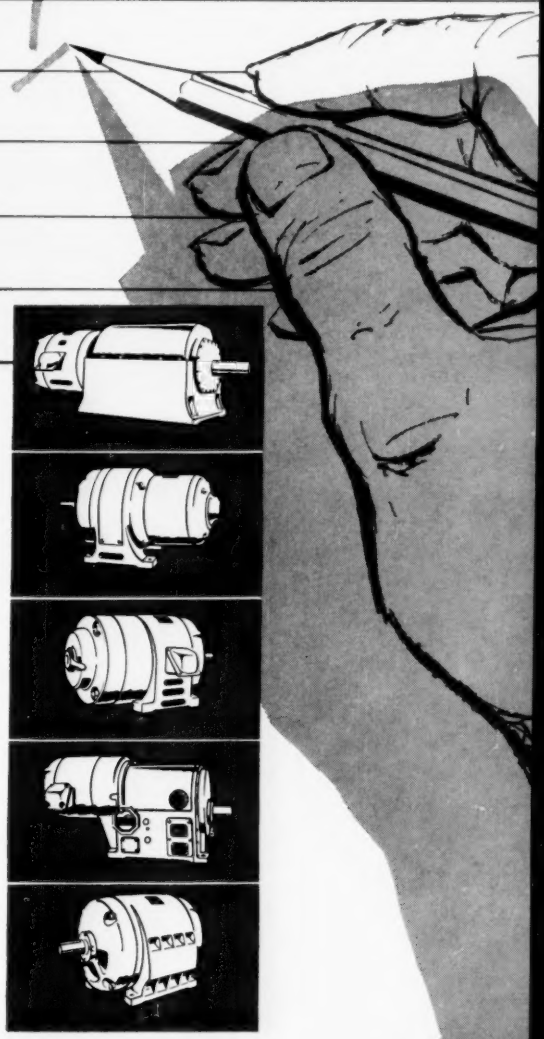

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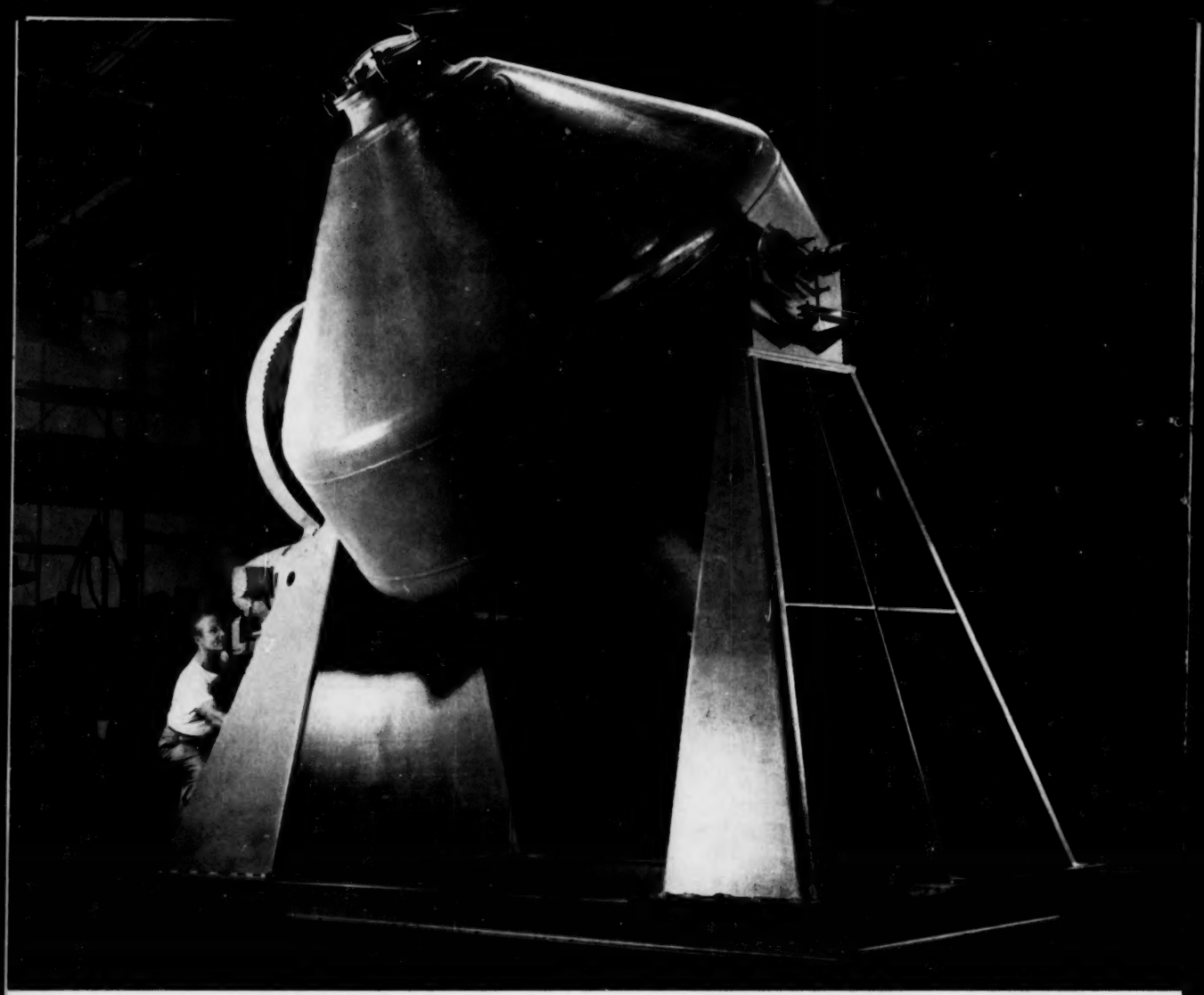

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